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PUBLIC WORKS

An Engineering and Construction Monthly

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CITY COUNTY STATE

PUBLIC WORKS is devoted to the design, construction, maintenance and operation of *public improvements.*

The major subjects covered are: Highways, Water Supply, Sewerage, Refuse Collection and Disposal, Street Cleaning, Bridges, etc.

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Obsolete Equipment and Contractors' Profits

In visiting some 25 or 30 highway construction jobs during the past few months, it has been shown time and time again that, except for a very few jobs of unusual character, no contractor can make money today if he is using obsolete construction equipment. But a surprising number of construction firms are trying to save a little by using old machinery, while losing perhaps a hundred times as much through delays due to minor breakdowns and to inability of these machines to speed up to modern requirements. The motor car makers have shown the way toward junking machinery that cannot keep pace in profits; and other manufacturers have followed suit. But the great construction industry hesitates, and makes the old machine give up yet another year's service.

The aged, infirm and slow motor truck, the serviceable but not so speedy paving mixer, the asthmatic and hesitating steam shovel and the gasket-blowing water pump are far past the dividend-paying stage. The wise contractor will retire them without undue ceremony to the junk pile, and replace them with modern, economical, high-speed equipment.

The ARBA Goes Ahead

To a staff already of very high quality, the American Road Builders' Association has added C. E. Grubb and Charles R. Thomas as head of the County and City Officials' Divisions respectively. We congratulate the ARBA. These are two fine men, who should go far in helping the ARBA to fulfill its function as a focus of road building activity. There is a very large field, as yet unappreciated by a good many who look no further than their own participation in the Annual Road Show, for the activities of this organization. A focal point is necessary, around which the road-building industry can rally to keep the road funds flowing, and the ARBA comes closer to supplying that focus than any organization. It ought to continue to go ahead as it has done for the past few years, and we believe it will.

J. T. MORRIS
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CITY COUNTY STATE
AN ENGINEERING AND CONSTRUCTION MONTHLY
Vol. 61 September, 1930 No. 9

Water Supply Problems in Holland

Sixty-one percent of the population use public water supplies, obtained from the dunes, other under-ground sources and rivers, about one-fourth of the systems being privately owned. The government advises communities through a special commission and subsidizes some undertakings. Geo-hydrological conditions described

By F. A. Liefrinck, C.E.,
Engineer, Government Bureau of Water Supply, The Hague, Holland

AS IS well known, the inhabitants of the Netherlands never have had much reason to complain of lack of water; on the contrary, water has been their greatest enemy ever since the first settlers chose the delta of the rivers Rhine, Meuse and Scheldt for their future residence.

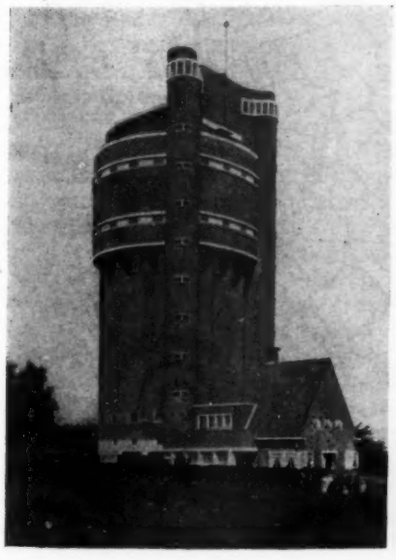
Unfortunately, most of this water, being either salt, brackish or polluted, is not fit for consumption; and as geo-hydrological conditions are unfavorable, great difficulties were, and still are, encountered in providing fresh and potable water for the steadily growing population, which at present numbers 7.7 millions.

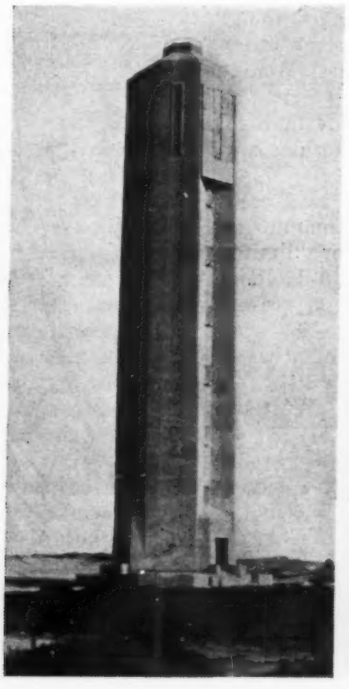
In this article some aspects of the country's "struggle for water," which may be of interest to American readers, will be briefly dealt with.

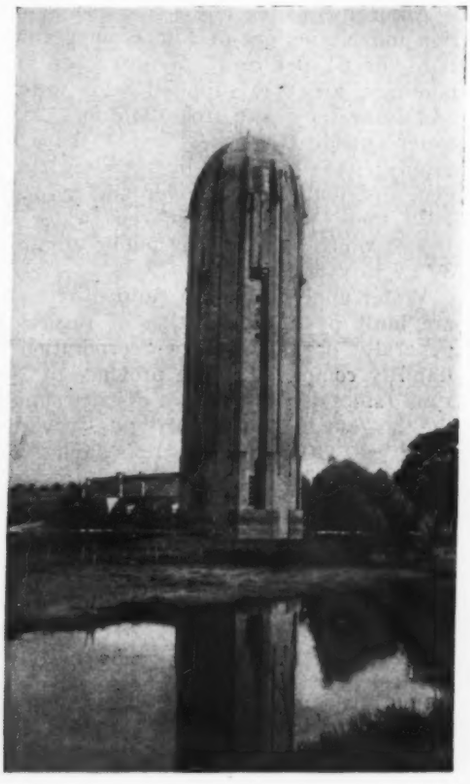
Some Facts and Figures

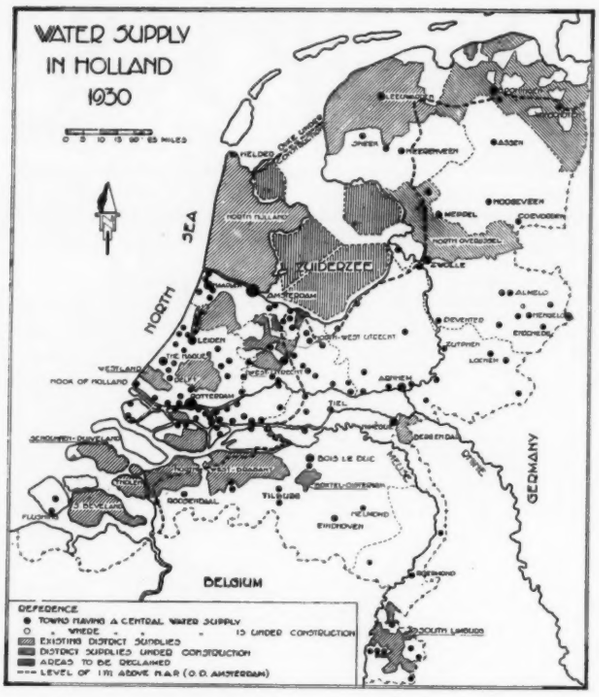
The oldest waterworks in Holland are those of Amsterdam, situated in the dunes south of Haarlem, which were finished in 1853 by English engineers, and for a few years were run by an English company. Three years later Helder followed suit, also taking its water from the dunes. In 1874 the river water-

Below: Water Tower at Schimmert. Architect, J. Wielders. Middle: Water Tower for Wireless Station at Kootwijk. Architect, J. Luthman. Right: Water Tower at Zutphen. Architect, H. Sangster.









Map of the Netherlands, showing towns and districts in possession of central water supplies

works were opened in Rotterdam, which at present furnish water to Delft, Schiedam and Vlaardingen also, and the Hague obtained a dune water supply; Leiden in 1878, Utrecht in 1883, and other towns and communities following in rapid succession. The towns and districts which have a central water supply and the works under construction are indicated on the map.

According to the latest statistics at hand, 4.7 million inhabitants out of a total population of 7.7 millions, or 61 per cent., divided over some 444 communities, are now supplied with water. Of these, 142 use water drawn from the dunes, 253 take ground water outside the dunes, and 49 have a river water supply; some of them, like Amsterdam and Groningen, distributing both river and ground water. In 1929 there were 148 different water undertakings, 109 of which were run by public administrations and 39 by private corporations.

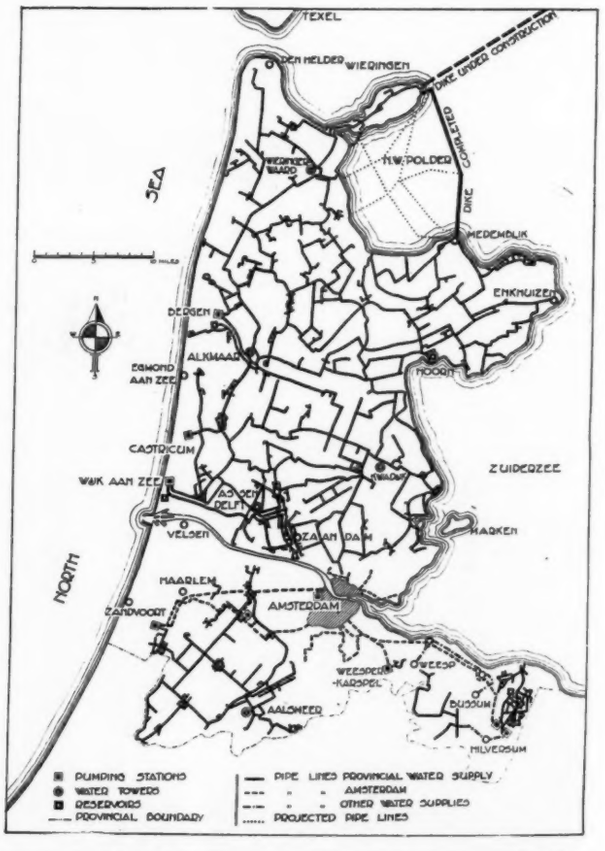
Water undertakings in rural districts in most cases are built by a combination of several communities, generally organized as a "corporation" or "limited liability company." The province of North Holland runs (since 1919) her own district supply, at present the largest in the Netherlands, covering 104 communities. Other rural districts having a central water supply include South-Beveland (erected in 1912; 24 communities); Tholen (1923; 7 comm.); Westland (1923; 5 comm.); North-West-Brabant (1923; 25 comm.); Leeuwarden-district (1925; 14 comm.); Kilwaterleiding (1926; 9 comm.); South-Limburg (1927; 27 comm.); West Utrecht (1927; 5 comm.); North-West-Utrecht (1928; 20 comm.); Tien Gemeenten (1928; 12 comm.); Schouwen-Duiveland (1930; 16 comm.). District supplies for North-Overijssel (22 comm.) and the Province of Groningen (40 comm.) are in preparation or under construction.

The daily per capita consumption in Holland will appear very low in comparison to American standards; in 1928 it averaged 25.1 U. S. gallons. This low figure may be due partly to the fact that industrial undertakings generally have their own sources of supply; but the rural population, who for centuries have been obliged to economize in potable water, are not extravagant in the use of a piped supply, even if no meters are installed (as is generally the case with rural supplies), while meters on city supplies discourage waste. The average daily figures for 1928 for some of the largest towns run as follows: Amsterdam, 29.3 U. S. gal.; Rotterdam, 30.2; The Hague, 18.5; Utrecht, 25; Groningen, 22. Water rates generally range from 20 to 50 cents per 100 cu. ft. for domestic purposes.

The Government and Water Supply

To advise the government in questions of water supply, a governmental Commission was installed in 1910; and in 1913 its annexed technical bureau was transformed into an independent service, the Government Bureau of Water Supply. This bureau draws up plans for and promotes the construction of rural supplies; it controls the state-subsidized undertakings; its services are also available for provincial and municipal authorities, as well as for private persons and corporations, for carrying out technical, chemical and geo-hydrological investigations and valuations. It also undertakes the direction and supervision of works under construction; all against reimbursement of actual cost. The bureau further collects and examines data bearing on soil and water; over 18,000 reports

(*Continued on page 65*)

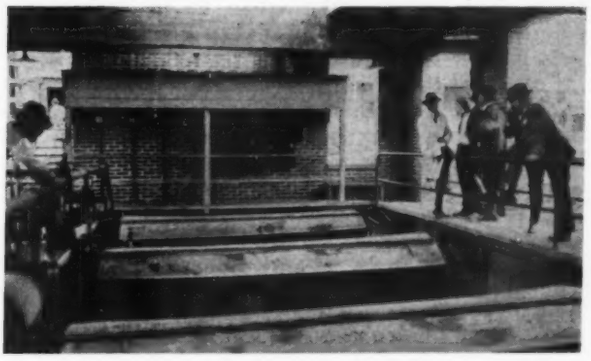


Province of North Holland, showing district water supply (104 rural communities) and water supply system of Amsterdam

Present Practice in Industrial Waste Treatment

By Ernest W. Steel

Professor Municipal and Sanitary Engineering, Agricultural and Mechanical College of Texas



North Screens used for Preliminary Treatment of Packing House Wastes, Forth Worth

The problems of industrial waste treatment are varied and complex. They are obtruding themselves more and more upon the notice of the state sanitary engineer, the sewage disposal plant operator, and others who are concerned with stream pollution, quality of water supplies and the treatment of sewage. Although it would be impossible to cover the subject adequately in this short article, a brief statement of what might be considered as standard practice can be given, although many further advances are to be expected

---

THE wastes which have been most troublesome in streams and at sewage disposal plants are those of paper mills, tanneries, packing houses, dairies and creameries, coke and gas plants, canneries, corn product plants, beet sugar factories, textile, dyeing and wool washing establishments and acid wastes from steel plants. Of these, the phenol wastes from coke plants, acid wastes from steel plants, and to some extent dye-stuffs, may cause trouble at sewage treatment plants because of their bactericidal properties. Phenol wastes are also important because of their taste-producing effects upon water supplies. The other wastes mentioned cause troubles because of their high oxygen demands, thereby overloading plants which have not been designed to take them. Some of them, as milk wastes, by their excessive acidity may upset the biological balance of a plant.

If the wastes are sufficiently diluted with domestic sewage, no disturbances will occur and the treatment plant need only be designed for the additional strength of the sewage. Where disturbances due to insufficient dilution by domestic sewage are to be expected, it is advisable to treat the wastes at the plant producing them and place the burden of treatment cost where it belongs—upon the industry itself. This proposition may be objected to by those who say that this gives unfair advantage to competitors who are more favorably situated. The favorable situations, however, are becoming fewer; the unrestricted discharge of industrial wastes into streams is being frowned upon by the public. This is proved by the fact that many state health departments have been making exhaustive surveys of stream pollution by industries and that associations of the canners and paper manufacturers have been financing investigations of treatment methods.

Noteworthy is the fact that intelligent investigation of the treatment of industrial wastes has prevented the loss of so much valuable material that treatment sometimes pays a profit. In other cases, treatment returns have broken even with costs or have materially reduced net costs. The re-use of treated water has been an important factor at many plants.

Milk Wastes

These wastes probably have received more attention than any others because of the universal distribution over the country of creameries, milk-handling plants, cheese factories, milk condenseries and pasteurizing plants. The wastes are made up of utensil, apparatus and floor washings, buttermilk and, in the case of cheese factories, more or less whey. It is impossible to treat whey economically unless it is highly diluted with other wastes. To a great extent, cheese factories are solving this problem by returning whey to dairy or other farms for feeding hogs.

Although milk wastes may contain much alkaline washing powder, they tend to become highly acid in a short time, due to the breaking down of lactose into lactic acid. For this reason, if filtration is intended, the waste, preceded only by grit removal, should be applied to the filters without preliminary treatment. Pretreatment in Imhoff tanks and septic tanks does more harm than good. Trickling filters 6 feet deep, operated at rates of about 2 million gallons per acre per day, will produce a satisfactory effluent. If only sufficient treatment is required to make the wastes suitable for final treatment at a municipal sewage disposal plant, application to a trickling filter 3 feet deep at 1.5 million gallons per acre per day should be sufficient.

Disposal of the untreated wastes on land of proper porosity at rates up to 10,000 gallons per acre per day has been successful. Serious odor troubles accompanying this method have been overcome by chlorinating the wastes as early as possible to keep them

fresh. This means chlorination at the milk plant before discharging into the sewers.

Milk wastes have also been treated by coagulating the casein of the milk and settling it out. The effluent is clear, the B. O. D. is much reduced, and chlorination is not necessary before disposing on land; and little dilution will be required for disposal in streams without nuisance. The coagulants used are ferrous sulphate, alum, and sulphuric acid. The last named is apparently the most effective. The sludge obtained dries slowly on beds. Sludge from waste coagulated with sulphuric acid might be used for hog and chicken feed.

Beet Sugar Waste

The wastes from beet suger factories are of three kinds: those from washing and conveying the beets, constituting 75% of the total; those from the diffusers and pulp presses; and lime wastes from carbonation and sulphitation.

The washer and conveyor water contains only soil particles and vegetable debris, and plain sedimentation is sufficient treatment.

The press and diffuser wastes are most difficult to handle. In Germany and England they have been fermented in two stages in ponds. In the first pond a highly acid fermentation occurs. The effluent of this pond is limed and is fermented in the second pond. The effluent of the second pond is then settled. Chlorine has been applied to the final effluent of this process.

Lagooning is the simplest available method of disposing of the sludges produced by fermentation and the lime wastes. Since beet sugar manufacturing is a seasonal matter, ponds and lagoons can be cleaned during the idle periods.

Combinations of all the wastes have been precipitated with lime and humate, settled in two stages, and finally treated on slag filters. Wash and conveyor water has been settled, chlorinated and returned to the factory for re-use.

Corn Products Wastes

These wastes result from the steeping of the corn and from washing the bone charcoal used in the refining process. A saving amounting to half a million dollars a year has been accomplished at Argo, Ill., at the plant of the Corn Products Refining Co.,[1] by evaporating the steep water and using the residue in the making of stock food. This process, together with the elimination of accidental losses of organic matter, lowered the population equivalent of the total waste from 800,000 to 50,000 and thereby obviated the construction of a waste treatment plant estimated to cost nearly three million dollars. The vapor of the steep-water evaporation process, when condensed, contains much organic matter and has a very high B. O. D. Investigations leading to further recoveries of valuable materials from it are being made.

The refinery wash water, which is hot and acid, has a B. O. D. of about 700 parts per million. Unsuccessful attempts have been made to treat it by activated sludge. Diluted with an equal amount of water, it apparently can be treated on trickling filters at the rate of 1.5 million gallons of the diluted liquid per acre per day and the oxygen demand be reduced 90%.

[1] Mohlman, F. W. & Beck, A. J., "Disposal of Certain Industrial Wastes"—Industrial & Engineering Chemistry—Vol. 21, No. 3, March, 1929.

Cannery Wastes

These are the wastes from canning or packing such vegetables as tomatoes, peas, beans, etc. Of these, tomato wastes present the greatest difficulty. They are the wastes from the peeling and scalding processes and wash waters from floors, utensils, etc. At Princeton, Ind.,[2] wastes from catsup making were first screened (.014-inch opening), then coagulated with lime and sodium aluminate and settled in a series of basins. The oxygen consumed was reduced from 2100 to 396 parts per million. The effluent has no turbidity and odor. It is discharged into a city sewer. Coagulation with lime and ferrous sulphate, settlement and application to sand filters will produce a colored, though otherwise inoffensive, effluent.

Wastes from the canning of corn, beans, and succotash are less troublesome. Sedimentation is effective, but fine screening (40 meshes to the inch) is sufficient to prepare the waste for final treatment on sand or trickling filters at the rates used for average domestic sewage.

Packing House Wastes

The important features of packing and slaughter house waste are the paunch manure and the high B. O. D. Some cities have required pre-treatment before allowing the waste to enter the sewers. Elimination of the paunch manure is easily accomplished by means of fine screens. Dorr clarifiers with grease skimming apparatus are useful, but the effluent will still be far higher in B. O. D. than untreated domestic sewage. Activated sludge plants are successful in treating these wastes, but when treated alone, long aeration periods will be required. When diluted with domestic sewage, the aeration period must be adjusted accordingly. Wastes from small packing plants have been satisfactorily disposed of on land.

Tannery Wastes

Wastes of this character have been treated very successfully. They consist in part of wash waters, which may be large in amount and very dilute so that they can safely be discharged into streams. The other wastes, which include the lime, bits of flesh and other organic matter of the beam house, and the tanning and bleaching liquors, either alone or combined with the wash waters, are treated by plain sedimentation, or by coagulation with alum followed by sedimentation. Plain sedimentation has the advantage of producing less sludge. Oxidation is accomplished on intermittent sand or trickling filters at somewhat higher rates than with domestic sewage. The sludge, which is not digested, dries readily on beds. It has some value as a fertilizer.

At Hamburg, Germany, a tannery waste treatment plant has been constructed in which the wastes are first settled in two-story tanks and then aerated with activated sludge and domestic sewage. The activated sludge was built up from domestic sewage and "habituated" to tannery wastes by treating increasing proportions. Final treatment is on intermittent sand filters, in the hope of eliminating anthrax organisms. The mat of material accumulating on the sand filters is scraped off and burned.

Textile and Wool Washing Wastes

The wastes from textile mills include washing wastes and rinsing waters, and contain soap, dirt,

(*Continued on page 76*)

[2] Holmes, J. A. & Fink, G. J., "Sodium Aluminate in the Treatment of Cannery Wastes," Industrial & Engineering Chemistry, Vol. 21, No. 2, February, 1929.

Efficient Operation of Concrete Paving in Pennsylvania

Second installment of article showing how Highway Department aids contractors in securing maximum rate of construction, and thereby reduces cost, without sacrificing high quality. Last year the average efficiency of the contractors was less than sixty per cent of that theoretically possible. How efforts are made to better this

By P. M. Tebbs

Assistant Chief Engineer, Pennsylvania Dept. of Highways

ON most of our concrete paving in Pennsylvania wire mesh or bar mat reinforcement is used, and the first course of concrete is struck off so that the reinforcement will be two inches from top of pavement. This operation has been performed by hand in the past, but this is a slow and expensive operation and we have experimented with and are recommending a mechanical strike-off. It consists of a templet mounted on small wheels which ride on the forms. Cables are attached to each side of the templet and to pulleys and a drum on the rear end of the mixer. The templet is pulled ahead by mechanical power. When the mixer moves, the cables are released. This permits the mechanical strike-off to remain on the forms at all times with the cables always attached. No time is lost in striking off the concrete and the reinforcement will always be in proper position. The reinforcement should be placed immediately after the concrete is struck off, so that there will be no delay.

Another method of mechanical striking off was tried by placing an additional plate on the front screed of the finishing machine, which could be lifted after the first course was struck off. This compelled the finishing machine to be in a certain location each time the mixer was moved, which was not possible without slowing up the operation or neglecting the surface finishing.

The final proof of the success or failure of any method lies in the results being secured. Our records for 1930 show two shining examples of what can be

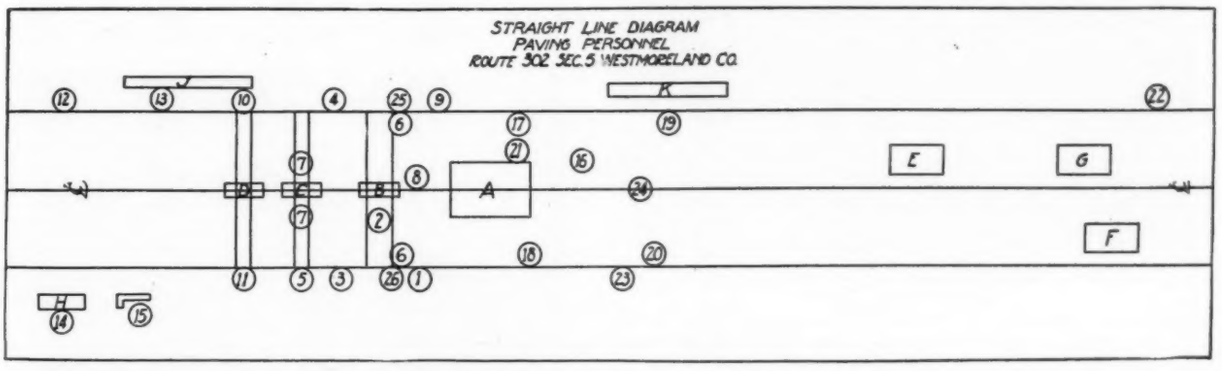


Chart showing location on the job of each man and piece of equipment

Equipment

A—27-E Multi-Foote mixer
B—Lakewood finishing machine
C—Cleft Center-line joint machine
D—Burlap rolling bridge
E—3½-ton roller
F—Power grader
G—10-ton steam roller
H—Team—night duty
J-K—Burlap racks
L—Plant shovel

Personnel

1 Foreman—Supervisor over entire paving organization.
2 Finishing machine operated under direct supervision of boss finisher.
3 & 4 Finishers on each side of center line to check for and rectify surface irregularities.
5 Foreman finisher in charge of all work back of the concrete pit.
6 Laborer riding screed at all times to keep concrete within the limits of the forms and ahead of the screed at all times.
7 Center-line finisher and helper with no other duties to perform.
8 Four (4) pit laborers to stay in concrete at all times —takes steel from spaders after strikeoff.
9 Handyman—keeps dowels clipped to steel, waters pit and sees that steel is in right location for quick location in the pit.
10 & 11 Burlap boys to place burlap from rolling bridge.
12 & 13 Burlap sprinklers with three (3) lines of hose, each 100 feet in length, all on risers to avoid loss of time changing hose from riser to riser.
14 Night crew—consisting of four (4) laborers, team and teamster to bring forward forms, burlap racks, headwall forms, pins and general cleanup from previous day's work.
15 Finisher, whose duties are to rub headwalls, patch honeycomb if any, and free all expansion joints and general work with finishers when these duties are completed.
16 Truck dumper with whistle; 1, stop; 2, ahead; 3, back, with instruction to effect quick truck release.
17 & 18 Form cleaners using 9 in. forms for 8 x 6 in. x 8 in. pavement; set 2 pins, one at each form; places expansion joint plates and keeps bulkheads in readiness.
19 Form setter and helper, directly ahead of mixer at all times with 10 ft. straight edge and keeps true line and grade of forms within area of truck passages.
20 Form oiler and handy man.
21 Calcium chloride laborer.
22 Two (2) skilled form setters and five (5) laborers for all form work.
23 Cement sack laborer—takes empty sacks from side of truck near mixer for baling.
24 Two (2) cement dumpers; after emptying cement on aggregates, sacks are placed on side-boards of trucks and removed by sack baler en route to mixer.
25 & 26 Two (2) spaders, one (1) at each form in pit; help clean pit, clean form lines, help pull strikeoff and assist pit crew in placing reinforcing.
27 Two (2) cement loaders at plant.
28 Two (2) laborers at plant for general work and channeling material cars for sampling.

Making Cleft-Type Center Joint; premoulded expansion material being inserted. Two men necessary because machine is propelled by hand; in new machines small motor replaces one man

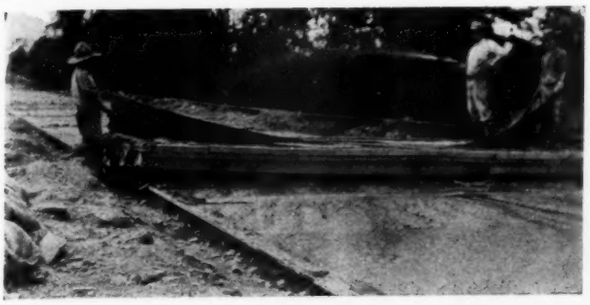
accomplished when a contractor adopts an "Amos" attitude, which may be described as being "inexperienced and admitting it."

One of the contractors in 1929 showed a time loss of 16.42 per cent and a production of 68.42 square yards per working hour, or approximately 16 batches per hour. In the spring of 1930, this contractor conferred with the representatives of this department with a view of increasing his production. The chief inspector, who had been trained formerly in railroad operation, had been a serious student of our proposed efficiency methods. His training in railroad matters had taught him that to insure success in railroad operation, each train had to be at a certain point at a given time. This is identical with the requirements of efficient paving operation.

The inspector first prepared a chart showing the number and location of each man in the organization and the location of each piece of equipment. The men

	Number of Working Hours						
Date	Possible	Lost	Actual	Per Cent Lost	No. Ft. Laid	Total Batches	Batches Per Hr.
April 30	11.25	2.25	9.00	20.0	599	282	31.3
May 1	11.25	2.25	9.00	20.0	627	276	30.7
2	11.50	2.00	9.50	17.4	723	304	32.0
3	7.00	2.00	5.00	28.6	450	192	38.4
5	12.00	2.00	10.00	16.7	894	380	38.0
7	11.00	1.33	9.67	12.1	813	344	35.6
8	10.50	1.00	9.50	9.5	827	349	36.7
9	11.00	3.25	7.75	29.5	624	267	34.5
12	10.50	2.00	8.50	19.0	733	313	36.8
13	11.00	2.00	9.00	18.2	709	308	34.2
Rain							
22	10.50	1.25	9.25	11.9	753	330	35.7
23	11.00	2.00	9.00	18.2	707	299	33.2
26	11.50	1.35	10.15	11.7	847	356	35.1
27	11.00	1.00	10.00	9.1	771	323	32.3
28	12.00	1.00	11.00	8.3	912	392	35.6
30	10.50	1.50	9.00	14.3	729	313	34.8
31	10.75	2.75	8.00	25.6	601	261	32.6
June 2	8.75	2.50	6.25	28.6	552	239	38.2
3	13.00	0.16	12.84	1.2	1143	489	38.1
4	11.25	2.50	8.75	22.2	739	315	36.0
	217.25	36.09	181.16	16.6%	14753	6332	35–

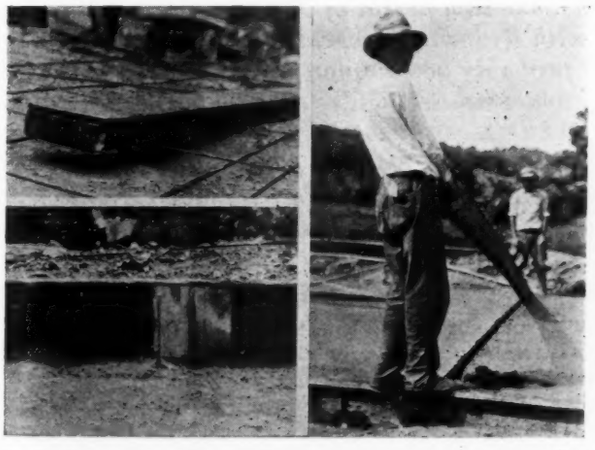
	Number of Working Hours						
Date	Possible	Lost	Actual	Per Cent Lost	No. Ft. Laid	Total Batches	Batches Per Hr.
April 26	6.60	1.30	5.30	19.7	228	141	26.6
27	11.00	1.25	9.75	11.4	491	236	24 3
28	3.33	0.75	2.58	22.5	137	72	27.9
29	11.00	3.67	7.33	66.7	424	208	28.4
30	11.00	3.08	7.92	28.0	382	186	23.5
May 1	11.00	0.33	10.67	3.0	601	290	27.2
2	12.25	0.85	11.40	6.9	664	324	29.1
3	11.00	0.17	10.83	1.5	625	308	28.4
4	12.50	0.45	12.05	3.6	706	338	28.1
7	12.00	1.50	10.50	12.5	698	333	21.7
8	12.25	1.00	11.25	8.0	639	310	27.6
9	12.25	1.00	11.25	8.0	672	328	29.1
10	12.50	2.00	10.50	16.0	568	272	25.9
12	12.50	1.75	10.75	14.0	699	332	30.9
13	12.50	0.50	12.00	4.0	823	396	33.0
17	12.50	1.00	11.50	8.0	750	356	30.9
21	12.50	1.00	11.50	8.0	714	352	30.6
22	15.50	0.50	15.00	3.2	1010	496	33.1
23	12.50	1.85	10.65	14.8	634	310	29.0
26	12.50	0.75	11.75	6.0	795	396	33.7
27	12.50	1.00	11.50	8.0	721	351	30.5
29	7.00	0.67	6.33	9.6	454	220	34.7
30	12.50	0.75	11.75	6.0	665	326	27.7
31	12.50	1.85	10.65	14.8	763	384	36.1
June 1	9.00	1.00	8.00	9.1	510	249	31.1
2	12.50	1.08	11.42	8.6	735	356	31.2
	295.18	31.05	264.13	10.5%	16108	7870	30–



Rolling Burlap Bridge, 22 ft. by 6 ft. by which burlap is kept clean and conveniently distributed and collected

were then called together before the operations started and their duties were explained to them. On the first day this paver operated, 599 feet was placed. On the fifth day, 894 feet was placed in 10 hours. The record of this job for the year to date on 18-foot width of concrete pavement with 9-inch edge thickness and 6-inch center thickness is given on page 24.

Our records show that this contractor had always considered 400 feet an excellent average day's work. His experience as a highway contractor had been very limited. When he arrived on the job on the day following the 894 feet run, his surprise was genuine and so intense that the only coherent statement he could make was: "Well I guess I will go home and eat a chicken dinner." This contractor later made a statement to a representative of the department that 80 per cent of the increased progress was due to suggestions and guidance of the chief inspector.



Left Top—Transverse expansion joint material wired to bulkhead; wires are broken after bulkhead has been staked in its proper position

Left Bottom—Expansion Joint Bracket, with lip which is placed directly under form to hold it in position. It insures perpendicularity of joint material; and eliminates opening the expansion joint next day as formerly done with chisel. These joints are removed directly after the forms are removed

Right—Three-inch wooden bulkhead being removed during the day. Wide bulkhead holds expansion material perpendicular and permits backfilling material in sufficient quantity to insure concrete being tight against expansion joint at all points

Top—Mechanical Strike-off at mid pit. Note amount of material carried in front.

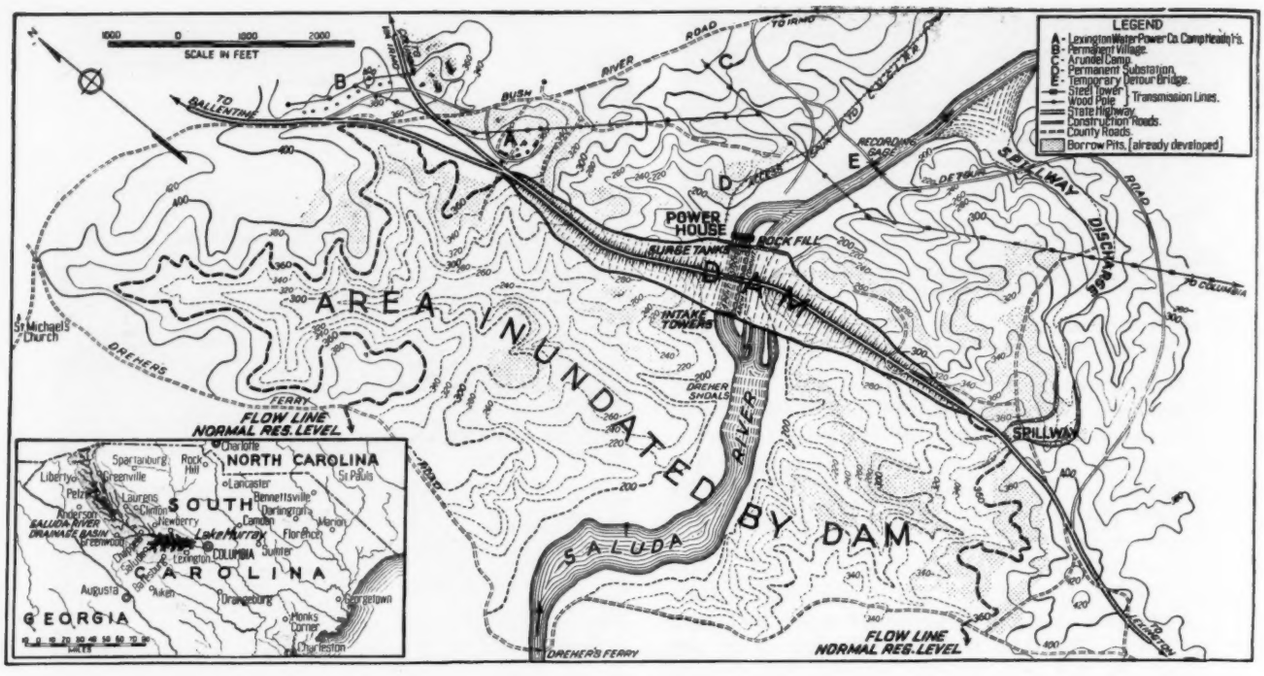
Middle—Reinforcement in position on previously struck-off concrete. Note uniformity of elevation of concrete

Bottom—Diagonal and transverse joint bars, as well as dowel bars wired to bar mat before the reinforcement is placed

The other project mentioned above showed a time loss of 32 per cent in 1929 with a production of 64.74 square yards per hour, or approximately 15 batches per hour. A new superintendent of "Amos" variety was the only real change in organization. The record of this job to date in 1930 is shown on page 24.

On this particular project the cement company sent

General view of material plant. Siding capacity of twenty cars of stone and twenty of sand. Stock pile of sufficient size to guarantee continuous paving. Batcher plant between stone and sand



Building the Hydraulic Fill Saluda Dam

In our June issue we described the Cobble Mountain dam, which was notable, among other things, for having a maximum height of 245 feet, as well as for being built by hydraulic fill with hydraulic excavation of the earth used. The Saluda dam, which will probably be completed this fall, is being built by semi-hydraulic fill, and while not so high as the Cobble Mountain dam—its maximum height is 212 feet—is more than ten times as long (7,838 feet on the crest as compared with 700) and is believed to be the largest high earthen dam in the world. Other similarities and dissimilarities will be noticed in reading the following description

THE Saluda river has its source in the Blue Ridge and Saluda mountains, flows southeasterly through South Carolina, and its waters ultimately reach the Santee river and the ocean. At Dreher Shoals, 10 miles from Columbia and 200 feet above the ocean, an earthen dam is being built for the Lexington Water Power Co. to create the Saluda River Hydro-Electric Development, almost in the center of the southern super-power system. This dam will form a reservoir (known as Lake Murray) 40 miles long, 14 miles wide at its widest point, with a surface area of 78 square miles and impounding 2,300,000 acre-feet of water. It will furnish a maximum operating head of 183 feet and average of 165 feet. The present power plant capacity is 200,000 h.p., to be developed ultimately to 300,000. All the power was sold, before construction started, to the Duke Power Co., Carolina Power & Light Co., and Broad River Power Co.

The drainage area above the dam is 2396 sq. mi., on which the rainfall (from records kept since 1897) varies from 65 in. at the source to 42 in. at the lower end, approximately 43 percent of which reaches the river, giving an average flow at the dam site of 3700 c.f.s., with 120,000 and 142 c.f.s. as the maximum and minimum, respectively. The maximum flow occurred during the construction of the dam, when 14 inches of rain fell in eight days, 68,000 c.f.s. being passed through the conduits built into the dam and the rest stored between elevations 250 and 307.5.

It was necessary to purchase 1100 individual tracts of land comprising 100,000 acres, of which 65,000 lay within a line laid off 5 ft. vertically above full reservoir level at elevation 360.

License for the project was issued by the Federal Power Commission in August, 1927, and actual construction commenced about a month later by W. S. Barstow & Co. as general contractor, which sublet building the dam, penstocks and intake tower to the Arundel Corporation. Murray and Flood are the engineers and Albert S. Crane, consulting engineer.

The Dam

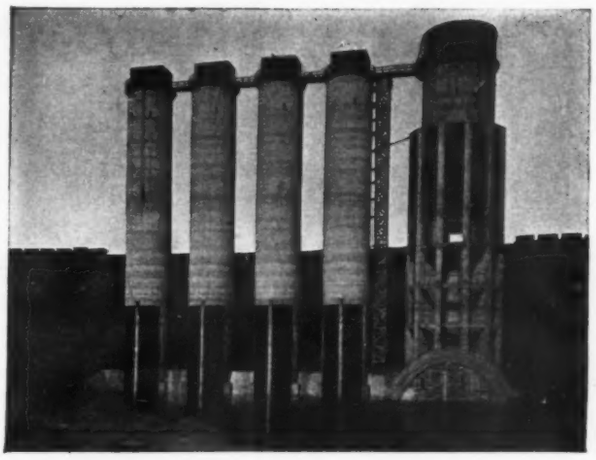
The dam is of the semi-hydraulic fill type, consisting of two outer dykes built of dry earth dumped from wooden trestles, between which a core is formed by sluicing earth from the inside faces of the dykes. The dam has a maximum height of 212 ft., crest length of 7838 ft., crest width of 25 ft. and maximum width at the base of 1150 ft., and contains about 11,000,000

cu. yds. of earth. The alignment consists of three tangents and two 4-degree curves. The slopes are 1 on 3 upstream and 1 on 2½ downstream. The upstream face is rip-rapped between lines 7 ft. above normal reservoir level and 60 ft. below, the draw-down limit. A rock fill has been built in the downstream toe of the dam across the old river bottom and bottom lands.

The spillway, located 500 ft. from the south end of the dam in the same general alignment, consists of a concrete ogee section resting on rock at elevation 325. With a 5 ft. rise in the lake (the dam has a 12 ft. freeboard) the spillway will pass one and one-half times the maximum flow recorded in 1929. The overflow discharges into a valley which joins the river three-fourths of a mile below the dam. An 18 ft. concrete highway crosses the valley on top of the dam and is carried across the spillway on a bridge of four spans supported by the piers which support four Tainter gates, each 37½ ft. by 25 ft., installed to control the lake level during floods.

Conduits and Intake Towers

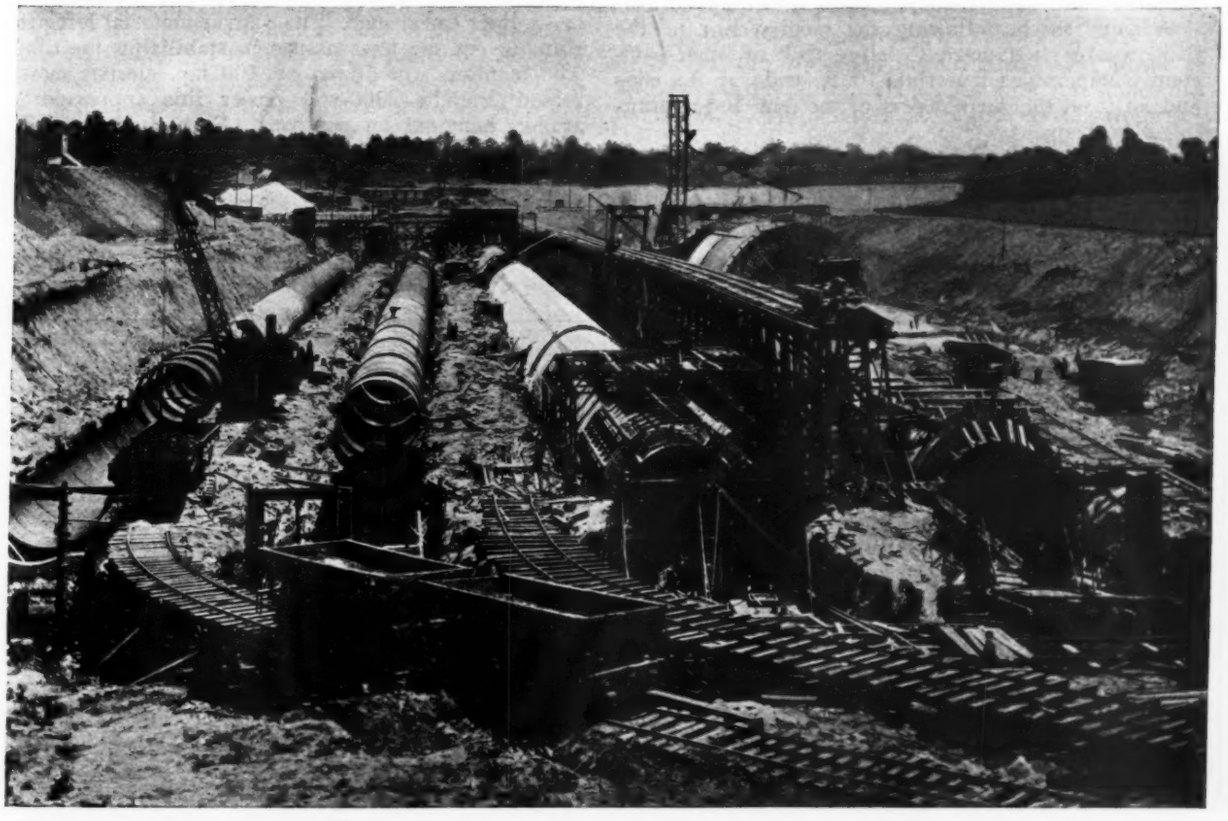
Water is withdrawn through the dam by means of four steel penstocks 16 ft. diameter and 986 ft. long; and a semi-circular concrete arch conduit 48 ft. wide and 23 ft. high provides location for two additional penstocks later. Each penstock is surrounded on the two upstream rings with two angles to minimize seepage along the pipe; also three concrete cut-off collars surround each penstock and the arch within the core, for the same purpose. The penstocks were laid on concrete cradles 18 inches high and 16 ft. apart, in trenches excavated in the rock about 9 ft. deep, and then surrounded with a concrete casing varying in thickness from 2 ft. 3 in. to 4 ft. 6 in., according to the hydrostatic pressure and weight of the earth above. Before the casing was poured, the pipe was braced at intervals on the inside to keep it a true circle.



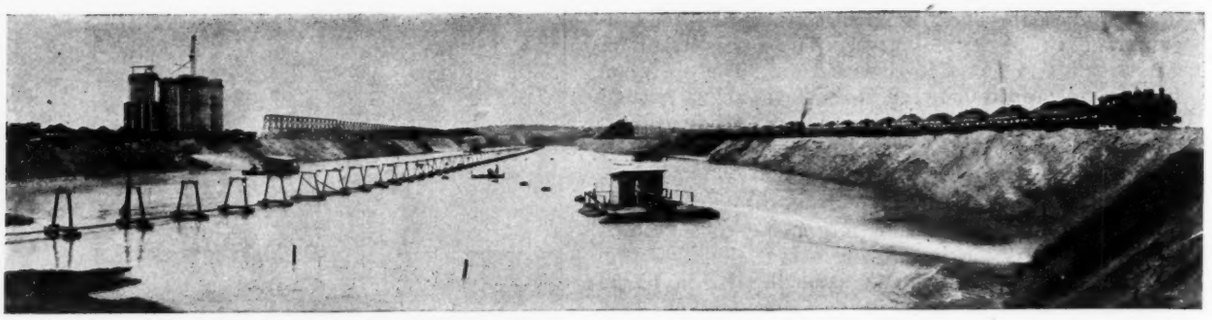
View of the five intake towers

The concrete arch conduit also varied in thickness from 4 ft. 7 in. to 9 ft. 3 in., with a section 15 ft. thick at the upstream end to support the intake tower. It was poured in 40 ft. sections, using inside wooden forms and outside steel forms supported by a steel traveling gantry. Before the water began to impound in the reservoir the upper end of this conduit was sealed with a concrete plug.

There are five intake towers, one at the upstream end of each penstock and of the arch. The penstock



The four steel penstocks and concrete arch conduit under construction



Monitor sluicing earth dumped by train from trestle at right. Trestles for the next lift under construction at the left. Frames on pontoons support power line. In the center, engineers taking samples of core material for testing

towers are 30 ft. outside diameter and the arch tower 60 ft. Each of the former contains two 9x14 ft. Broome self-closing sluice gates; while the arch tower contains six 10x10 ft. gates of the same type. Each gate is operated by an electric-driven hoist set in a small operating house on the top of the tower.

At each end of the conduits is built a retaining wall, that on the upstream end being 23 ft. high and 300 ft. long, while the downstream wall is 33 ft. high from its rock foundation and 300 ft. long.

Building the Dam

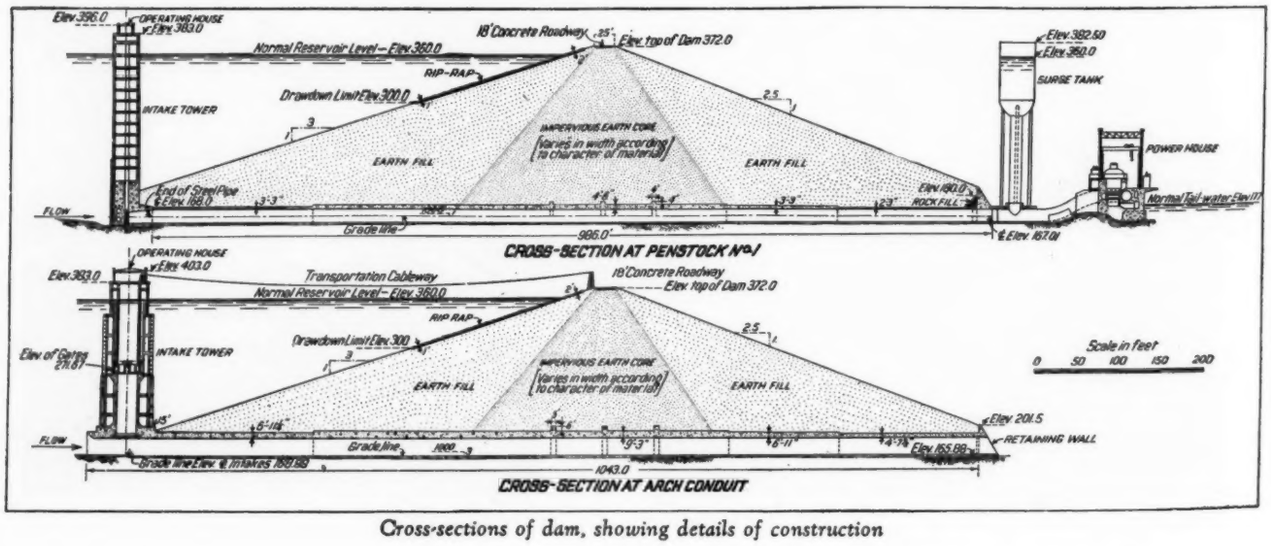
The 110 acres covered by the dam was cleared of all trees and brush, and the grass burned or cut off. That under the impervious core was stripped of sod and loam to an average depth of two feet, and all stumps and roots larger than 1 in. diameter removed 6 in. deeper. In the rest of the area all stumps and roots larger than 1 in. were grubbed out to a depth of 6 in. and all litter removed; and on the upstream area all loose rock, boulders and gravel were removed.

A core trench, following the median line of the dam, was carried down to ledge rock or other sufficiently impervious material, 10 ft. wide at the ends and 50 ft. at the deepest part of the dam and averaging 3 ft. deep.

Two lines of trestle 25 ft. high were built, one for each dike, and the earth dumped from these. After the fill had reached the top of the trestle, the dike was widened by dumping from movable tracks laid on the fill, both dikes being kept at approximately the same height and width. Another trestle was then erected on each dike and filling continued; seven pairs of trestles having been used in constructing the full height. The trestles were of timber, with mud sill, two or four legs (depending on size of timber) braces, caps, stringer blocks and stringers. The earth was brought from the borrow pits in side-dump cars. The final slopes of the dam were obtained by use of draglines and a small force of hand laborers. The downstream slope is planted to Bermuda grass. The riprap on the upstream slope was laid of one-man stone to a thickness varying from one to two feet.

Meantime the clay core was being formed by washing the fine material from the dumped earth into a segregation pool maintained between the two dikes. Five hydraulic monitors, mounted on housed pontoons floating on the pool, sluiced the clay and fine sand from the inner sides of the dikes into the pool, the width and depth of which were controlled so that the middle sixth of the dam is composed of material of which at least 65 percent passes a screen having 100 meshes per lineal inch. The coarser material left after sluicing out the fines assists in stabilizing the dikes. The monitors are driven by 100 h.p. electric motors served from a 2300-volt power line supported by frames mounted on pontoons. Each discharges 750 g.p.m. of water through a 1½ in. nozzle with a 300 ft. head, and is easily manipulated by one man. A pump with a capacity of 2800 g.p.m. maintains the pool at the desired depth, averaging 9 to 10 ft. Frequent soundings were taken in the pool to determine

(*Continued on page 74*)



Cross-sections of dam, showing details of construction

Snow Removal Practice in Three Cities

Methods and equipment employed by Brockton, Mass., Allentown, Pa., and Ottawa, Canada

Snow Removal at Brockton

By Harold S. Crocker
City Engineer, Brockton, Mass.

The City of Brockton, Mass., situated 20 miles south of Boston, covers an area of 21½ square miles, and has a population of about 65,000. The mean temperature for the three coldest months of the year will average about 30 degrees. The mean snowfall for each winter is about 39 inches. There is a wide variation in the amount of snow annually, however. The fall has varied from 10¼ inches to 76 inches—typical of New England!

There are about 140 miles of public streets in the city and about 30 miles of private ways that have to be cleaned of snow, for the benefit of traffic as well as for the preservation of the pavements.

Snow removal is done by city labor and city equipment. It is executed under the direction of Arthur J. Creeden, superintendent of streets. The city is divided into districts and each unit is assigned to its division of the work.

The equipment used for opening up the highways to traffic after a snow storm consists of two 5-ton tractors, two Wehr graders, two Barber Greene snow loaders, fourteen A-shaped plows attached to trucks, one Walter Snow Fighter, and fifty horse-drawn sidewalk plows.

The Walter Snow Fighter is used on the main highways and patrol. The trucks with the plows attached are used on all streets through the "in town" districts, and the tractors are used on the outlying districts. The Barber Greene loaders are employed in the business district. They load into trucks and also horse-drawn carts, which cart the snow to large drains, streams or other places suitable for dumping.

Plowing starts when the depth of falling snow is two inches. Work continues until sufficient width is obtained so that practically normal use of the highways results. While no exact figures are available, the cost of the original clearing probably amounts to about twice the cost of the widening operations.

No snow fences are used by the city department to prevent drifting snow. There are, however, sections of the highways on the outskirts of the city that are cleared by the Massachusetts Department of Public Works, that have fencing to prevent drifting.

The local highway department does not go into accounting thoroughly enough to furnish exact cost of snow removal per mile of street, based on depth of snow fall. The equipment that is used in the winter for "snow fighting" is of course made use of in the warmer weather for street construction and maintenance. No overhead charges are made to the snow removal account.

The past winter the total snowfall was 30 inches—somewhat below normal. The total expenditure of direct labor and material, including gasoline, oil, etc., was $9,580.98.

Sidewalks that are slippery after plowing receive a coating of sand, and at the intersection of those streets where there is quite a grade sand is spread to assist motor vehicles to come to a stop before they enter another traffic lane. The direct labor and material chargeable to the sanding process cost $5,787.99.

The effect of last winter's snow storms upon this year's budget at Brockton, as far as the highway department is concerned, is $15,368.97, which will mean that the tax rate will be affected to the extent of less than 20 cents per $1,000 of valuation. This is a very insignificant amount for the benefits derived by the public from work that is well planned, laid out, and executed by the Highway Department.

Snow Cleaning in Ottawa

By L. McLaren Hunter
City Engineer's Dept., Ottawa.

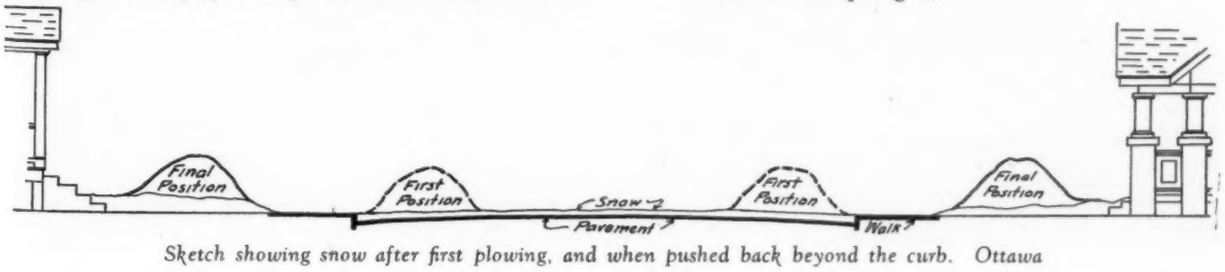
Ottawa, the capital of the Dominion of Canada, is situated in the valley of the Ottawa river, 258 miles north-east of Toronto and 129 miles west of Montreal.

Up to three years ago very little snow ploughing and removing was done, although the sidewalks have always been ploughed, and also the streets where street cars operate. But with the general use of autos and trucks in winter and the complete motorizing of the fire department vehicles, all streets had to be ploughed. Previous to this the fire department had to keep horses for winter use to haul the ladders, etc., these being mounted on steel runners (sleighs).

In Ottawa the average snowfall amounts to between five and six feet for the four winter months.

The snow removal is handled by the Commissioner of Works Department and comes directly under the Superintendent of Streets. The following equipment is used:

3 Walter snow fighters,
2 Fordsons with ploughs,



Sketch showing snow after first plowing, and when pushed back beyond the curb. Ottawa

1 Caterpillar with plough,
46 Team ploughs (for walks),
10 Single-horse ploughs (for walks),
13 "Walkaway" ploughs (used to shove the snow into the street to make room for the next storm's supply),
20 Snow removal boxes.

There are 260 miles of sidewalks and 165 miles of streets to be ploughed. The sidewalks are cleared, after an ordinary storm, in about half a day, and the streets in approximately two to three days (working night and day).

When the snow on the residential streets starts to narrow up the streets so that automobiles have difficulty in passing each other, the large Walter ploughs are used to push back the accumulation behind the city sidewalks, as shown in Fig. 1. In the central, or business district, the snow is ploughed in the manner described and then carted away to a dump. The average cost for removal is 28 cents per cubic yard. Twenty snow boxes and 100 men are used to remove the snow, each box holding six cubic yards. In the largest storm of last winter approximately 10,000 cubic yards of snow was carted away.

These snow storms help greatly the winter unemployed, as nearly 300 men are used for several days during and after the storms.

The Walter snow fighters used by the city, two of them of 100 h.p. and the other 125 h.p., are equipped with Frink Railroad V ploughs and wings.

During the summer months the ploughs are taken off the trucks and the latter are used for hauling asphalt to city paving jobs. They are kept going the full twelve months of the year.

The expenditure during the winter of 1929-1930 was $74,377.99, made up as follows: Sand, (after thaws, for sidewalks) $2,826.28; labor, sanding $13,606.20; roadway ploughing, $20,039.88; labor, shoveling, etc., $34,923.78; ditching, $2,981.85.

The Ottawa Electric Railway Company looks after the ploughing and removal of snow on streets which it uses for its cars.

Snow Removal in Allentown, Pa.

By Earle W. Meckley

City Engineer, Allentown, Pa.

THE maintenance of traffic during and after a snow storm over the streets of Allentown is accomplished by the co-operation of the City Highway Department, Lehigh Valley Transit Company and the street cleaning contractor.

Statistics show that we may expect one or two heavy snow falls in one year, averaging about eight inches in depth. Our policy is to start with plowing and removal operations as soon as a depth of three or four inches of snow has fallen.

The franchise of the street railway company requires it to remove the snow from curb to curb on certain streets. It operates car plows and brooms as soon as a few inches of snow has fallen, and as soon as the snow is at the proper depth, they supplement their car equipment with motor truck plows and push the snow to the curb. As the snow accumulates from the plowing operation and from cleaning the sidewalks, the company starts its Barber-Greene snow loader to work. The city furnishes the motor trucks for the removal operation on streets that have no franchise requirements, and the transit company performs the entire operation where their franchise requires them to do so.

On the streets that have no car tracks, the street cleaning contractor and City Highway Department co-operate, the city paying the contractor for his work on a cost plus basis. The loading of snow is accomplished by hand labor, gasoline shovel equipped with an over-size bucket, or by means of the Barber-Greene loader of the transit company, which is rented on an hourly basis depending on the quantity and extent of the work.

Some difficulty has been experienced in securing a convenient and accessible place to dispose of the snow after it is loaded on trucks. This problem has been solved by dumping from nearby bridges into the stream beneath, by removing a section of the bridge

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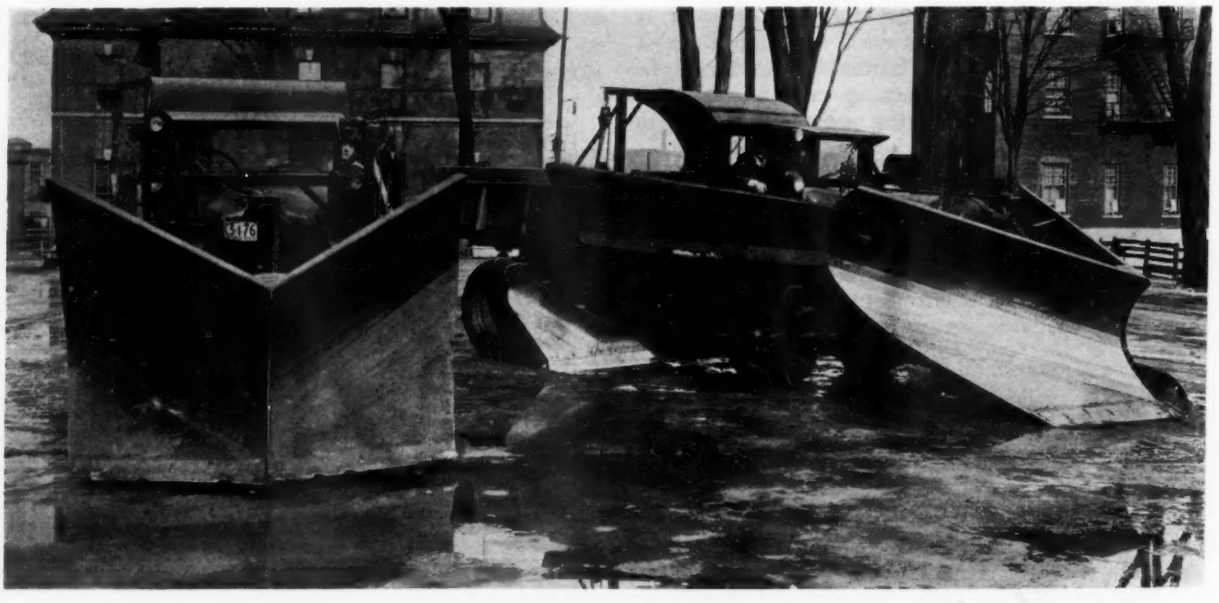
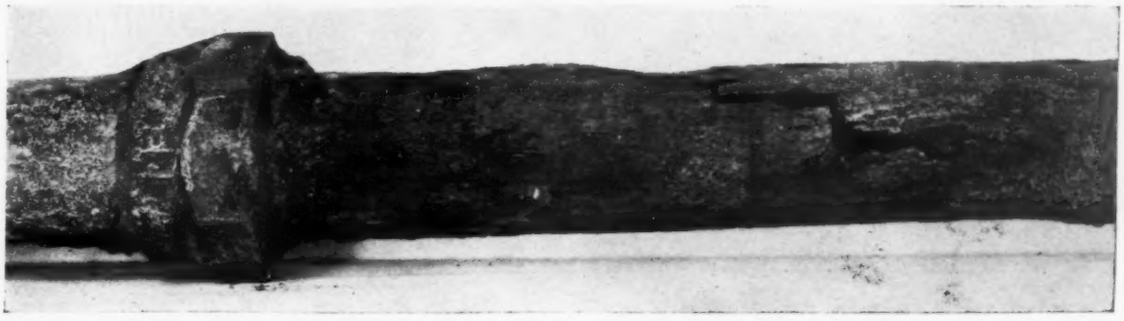


Snow fighters used by Ottawa



Specimen of Electrolytic Corrosion. Section of pipe removed from service line between the lead tail piece and the curb stop in the street. This service was renewed twice within four months. The destruction was traced to a leak in a high-tension line. The pipe was made of genuine wrought iron and laid in fairly dry gravel soil

Corrosion in Underground Iron Structures

The following is part of a report prepared by the author regarding the electrolysis of a well strainer in central New Jersey. While it refers especially to pipe, it applies to all iron under ground. It explains, concisely and clearly, a subject of considerable importance to all engineers

By Michael J. Blew

Major, Sanitary Reserve, United States Army

ALL corrosion of iron structures in the presence of ground water is essentially of an electrolytic nature. Such terms as "self-corrosion," "electrolytic corrosion," "galvanic action," and "stray current electrolysis" have been used to distinguish the different forms of corrosion. Either self corrosion or electrolytic corrosion is responsible for most cases.

Self Corrosion.—Decomposition arising from electric currents which originate in the metal structure itself is distinctly a reaction of this nature. Galvanic action is such a reaction.

Galvanic Action.—Strictly speaking, galvanic action is the current developed when two unlike conductors of electricity come in contact with each other in the presence of an electrolyte. In the case of the corrosion of pipes, it is caused by the physical and chemical differences existing between adjacent points on the surfaces of the metal pipe and foreign particles in the soil adjacent to the pipe, such as coke cinders, iron rust, fragments of metal, etc., which generate a local galvanic current.

Galvanic action may arise when two sections of pipe composed of different metals are joined together. A welded joint, or the unprotected threads of a galvanized pipe, may give rise to a galvanic action. Galvanic action may also result from the presence of foreign matter within the structure of the iron itself. Impure iron corrodes much more quickly and uniformly than pure iron. Pitting of iron is due to foreign particles in the metal near the surface, and is the main source of destruction of iron structures underground. The use of a more homogeneous iron reduces this action. The degree of pitting is strongly influenced by the nature and concentration of the surrounding electrolyte.

Electrolytic Corrosion.—This term is used to denote decomposition arising from the passage through the pipe or iron structure of an electric current, which has its origin in, and enters the iron from, some external source.

Such a current may be due to direct contact between light or power conductors and the structure. This action arises largely from defective insulation. Stray currents and leakage from electric railways and grounded power lines likewise have a pronounced influence in promoting corrosion.

Mixed Corrosion.—These two classes of corrosion are not independent of each other, and the presence of one kind of corrosion generally affects the nature and extent of the other to a very marked degree.

Formation of Galvanic Couple.—When a new pipe is laid in the ground, the discharge of a current through it causes the starting of corrosion, which in turn causes the deposition of a very small amount of iron oxide on the surface of the metal. Iron oxides are fairly good conductors of electricity and are electro-negative against metallic iron. When the newly formed iron oxide comes in contact with the metallic iron of the pipe, a galvanic couple is formed, which generates a galvanic current and rapidly corrodes the structure.

Products of Corrosion.—The electrolytic decomposition of iron yields ferrous oxide. Oxygen in the soil or water surrounding the metal oxidizes the ferrous oxide to ferric oxide. Hydrated ferrous oxide is a pale green color and the ferric oxide is yellow. When other

Specimen of Electrolytic Corrosion. This nipple was removed from the service line at the point where it entered the cellar, at main shut-off. The ground wire for the lighting circuit was attached to it

salts are in solution in the electrolyte, as is usually the case, other deposits are formed such as iron chloride and iron sulphide.

The degree of oxidation depends first upon the concentration of oxygen in the electrolyte and, second, upon the rate of corrosion of the iron structure. If the rate of corrosion is low and the concentration of oxygen is high, there will be more ferric or yellow oxide formed. When the rate of corrosion is high and the concentration of oxygen is low, the lower oxides are formed (ferrous and magnetic). The same thing applies to cases of self corrosion. As a rule, structures buried in soil and subject to self corrosion decompose slowly enough to permit the formation of yellow ferric oxide. On the other hand, electrolytic corrosion proceeds faster and ferrous oxide is usually formed. Thus the color of the deposit becomes to some extent an index of the nature of the decomposition taking place.

Efficiency of Corrosion.—The co-efficient of corrosion or the efficiency of corrosion is the measure of the actual amount of corrosion as checked against the theoretical corrosion as calculated from physical laws.

Effect of Moisture.—Corrosion is almost nil in dry soils and almost complete in water-saturated soils. It is also practically nil when the water content of the soil is less than 20 per cent, although corrosion varies with the type of soil. In water-saturated soils, corrosion may vary from 20 per cent to 140 per cent depending upon the current density. In such cases, the current densities will vary from 0.05 to 5.0 milliamperes per square centimeter of surface.

Effect of Chemicals.—Corrosion is a direct function of the quantity and character of chemicals dissolved in the electrolyte. The most active chemical compounds found in most underground waters are the sulphates and chlorides.

Circulation of the Electrolyte.—When a current is passed through an electrolyte, the acid radicals (Cl and SO_4) congregate at the anode and self-corrosion is increased. Liquids that contain a large amount of chlorides and sulphates are therefore very active on iron structures underground.

This also helps to explain the presence of iron sulphide in the desposit removed from corroded pipe. In the case of the corrosion of well casings and strainers by self-corrosion, the action of the pump in keeping the underground water in circulation would act as an aggravating agency by constantly supplying a fresh quantity of salt-bearing electrolyte to the galvanic couples already in action.

Temperature.—Very little effect is produced by changes in temperature within the ranges ordinarily met in practice. It does have a pronounced effect by changing the conductivity of the earth and influencing the rate of transference of electric current.

Voltage.—Corrosion is not directly associated with voltage, except that it affects current density. Voltages from 0.1 to 10.0 give practically the same coefficient of corrosion.

Current Density.—The amount of corrosion that occurs is largely a question of the quantity of electricity that is being discharged from a given surface. In general, the efficiency of corrosion is inversely proportional to the current density. The lower the current density, the greater the coefficient of corrosion.

Depolarising Effect of Oxygen.—All iron-work contains sufficient differences in physical and chemical composition at different points to start up local galvanic couples. Under ordinary conditions, certain points on the surface of the iron will be positive and discharge directly into the electrolyte while other points nearby will be cathode points and receive current from the electrolyte. The degree and rate of corrosion will depend upon the resistance offered to the local currents as well as upon the effective differences in potential between the two adjacent points. When a current flows in these local paths, a film of hydrogen is formed at the cathode which diffuses slowly, sets up a counter electromotive force, and introduces additional resistance into the local circuit. This has a tendency to inhibit the local galvanic couples and to minimize their corrosive action. If we pass a current through the metallic structure, making it positive, more oxygen will be liberated near the surface of the metal, which will then react with the hydrogen and depolarize the local galvanic element, thereby permitting greater self-corrosion.

Reversible Reaction.—When the circulation of the electrolyte is restricted, the corrosive process is somewhat reversible, with periods of reversion longer than with a liquid electrolyte. The extent to which the corrosive process is reversible depends upon the freedom with which the electrolyte is circulated, and particularly upon the freedom of access of such substances as oxygen, carbon-dioxide and hydrogen sulphide, which may result in secondary reactions giving rise to insoluble precipitates of the corroded metal. For this reason, corrosion is greater with a longer cycle, since the longer the period of contact, the greater is the effect of the secondary reaction.

Different Kinds of Iron.—Wrought iron, machined steel, and machined cast iron all react about the same, with only slight differences in the degree of corrosion. Cast iron corrodes more uniformly than the others. The principal cause of corrosion in cast iron is the galvanic action between free carbon particles in the metal and the iron itself. The carbon is so uniformly distributed throughout the metal that no pitting occurs, and the corrosion is less conspicuous. The least corrosion occurs in unfinished cast iron, probably because of the protectiove coating of scale.

Resume.—The variables affecting the corrosion of metal structures underground might be listed as follows:

(1) The current density at the surface of the metal.

(*Continued on page 70*)

Barrington Sewage Treatment Plant

Clarified sewage is treated by mechanical aeration, and settled effluent is filtered through sand and chlorinated. Sludge digestion tanks and glass-covered drying beds.

By E. Bender
Roberts Filter Mfg. Co.

THE Borough of Barrington, Camden County, N. J., had a population of 1,333 by the 1920 census but a more recent census gives 2,250. The borough is divided into three drainage districts, two of which have recently been provided with a sanitary sewer system, but the third district, which is sparsely populated, is not yet provided with sewers. The plant, therefore, takes the sewage from a present population of about 2,000, but has been designed for a future population of 6,000 with one hundred gallons per capita flow.

The plant consists of a grit and screen chamber, a clarification tank, aeration tank, final settling tanks, a filtration plant, contact tank, sludge digestion tanks, sludge drying bed, water heating plant and low-level pumping station.

After passing through the screen and grit chamber, the sewage remains about an hour in the clarification tank, from which it passes through the activated sludge tank where it is activated for approximately six hours, and then passes through final settling tank where it is detained for about one and a half hours. The effluent from this passes through a sand filter at the rate of approximately one and one half gallons per square foot per minute, and is then treated with chlorine and discharged into a small stream which has very little pollution. The solids which settle in the clarification tank, and the activated sludge which is not required for mixing with incoming sewage (which it is estimated will be about 75% of the total) are run into sludge digestion tanks with a capacity of 2 cubic feet per capita. Gas is collected from these tanks and is used for heating the digestion tanks and also for heating the filter building. The digested sludge is run onto glass-covered sludge drying beds with an area of 2 cubic feet per capita.

The sewer system has not yet been completed and the plant, therefore, has not yet been placed in operation, but it is expected that the effluent will be stable. As the plant is situated some distance from the nearest water main, a separate water system has been installed.

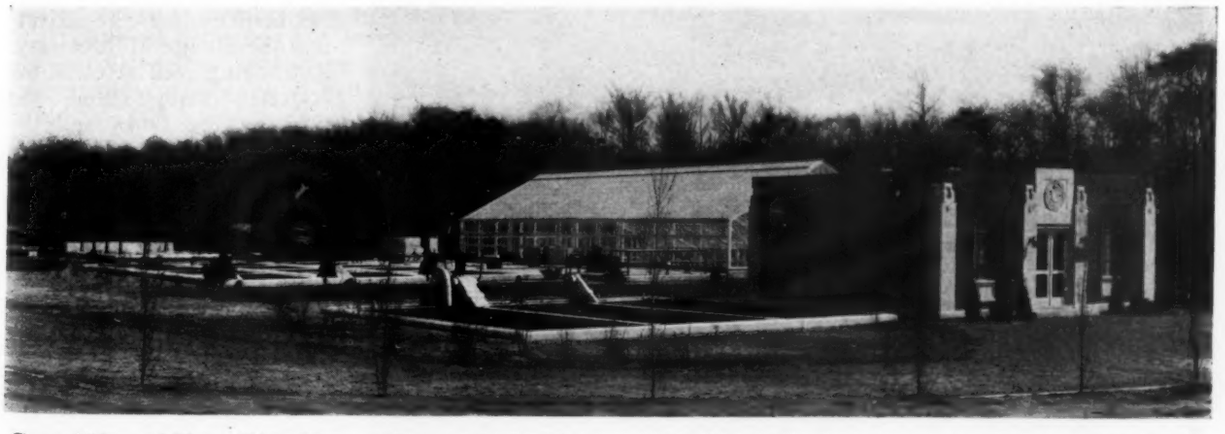
It is expected to use the grit which is collected for fill, and also the dry sludge unless some of it can be disposed of for fertilizer.

Grit Chamber and Clarification Tank

The sewage passes through an 18-inch cast-iron outfall sewer to the grit chamber which is 4 ft. by 6 ft. by 7 ft., 6 in. deep, with a hopper-shaped bottom which is provided with a 6-in. blow-off line. A bar screen consists of bars with a clear 2½ in. between them, set at an angle of approximately 45 degrees with the horizontal. It is manually raked from a platform above, onto which the screenings are deposited and allowed to drain off.

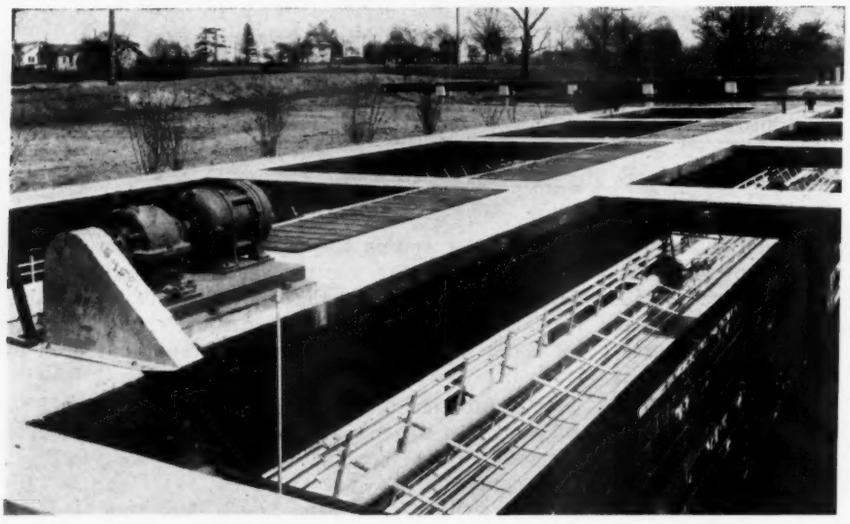
The sewage flows from the grit chamber over two V notch weirs 7½ in. high with 90-degree notches, into a flume, from which two 6-in. plug type valves admit it into either compartment of the clarification tank. There are two such compartments, each 8 ft. by 32 ft. by 11 ft. deep, each containing two hopper-shaped sumps. An 8-in. cast-iron sludge pipe rises from each sump and is carried through the wall of the tank and discharges by hydrostatic pressure into a rising well at one end of the sludge digestion tank.

On one side of the grit chamber is a concrete box, connected to it by a 2-in. pipe, in which a float records the height over the V-notch weirs, the recording device being located on the operating floor of the filter house.

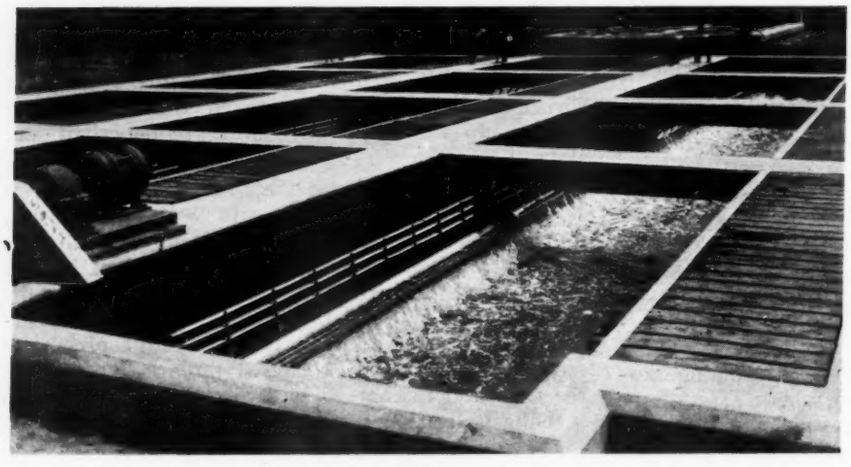


General View of Plant. Filter House at Extreme Right, Glass-covered Sludge Bed in Rear Center. Front Center, Final Settling Tanks; Behind These, Aeration Tanks.

The sewage leaves the clarification tank over four rectangular weirs, each 2 ft. 11 in. long, into a chamber 18 in. wide by 9 ft. 6 in. long and then over three 90° V-notch weirs 6 in. high into 20-in. square concrete boxes, from which 6-in. cast-iron pipes lead it to three aeration tanks.



Aeration Tank, Empty. Shows Aerator Paddles. Wooden Baffle Wall at Right Sewer Outfall to Plant in the Rear



Mechanical Aerator in Operation

Sludge Collectors in Final Settling Tanks

Aeration Tanks

Each of the aeration tanks is 12 ft. 6 in. by 60 ft. by 14 ft. 6 in. deep, or 12 ft. deep from the surface of sewage. Each tank has a slotted inlet and outlet baffle arranged to divert the sewage downward.

Each tank is equipped with a Link-Belt mechanical aerator which runs the full length of the tank, the ends supported on ball-bearing brackets, with intermediate brackets mounted on concrete buttresses spaced 15 feet centers. A baffle made of 2 in. cypress planks set 18 in. from the wall runs the full length of each tank, carried within 18 in. of the floor and about 24 in. down from the top of the tank. On the side of the tank opposite the aerator, near the top of the tank, a concrete deflector is built to give a rotary motion to the sewage. The top of this deflector is covered with wood, forming a walk-way. Each aerator is driven by a 7½ H.P. motor with a speed reducer, connected by sprocket and chain with the aerator shaft. Opposite each motor is a starter which is operated by a push button on the switch-board on the filter operating floor.

Activated sludge is introduced into the incoming sewage between the concrete wall and the wooden baffle through a 3 in. cast-iron pipe leading from a concrete distributing box located over a rising well at one end of the sludge digestion tank, where provision has been made for re-activating the sludge if necessary. This rising well receives the activated sludge from the final settling tanks and the sluge is raised from the well into a distributing box by means of an air-lift actuated by a float-operated air valve. The sludge that is not returned to the raw sewage is discharged into sludge digestion tanks through a 6 in. cast-iron pipe.

The aerator imparts a spiral motion to the sewage which mixes the sewage and

(Continued on page 80)

THE EDITOR'S PAGE

Hydraulic Fills for Dams and Levees

The highest earth dam, the Cobble Mountain dam, was described recently for the readers of PUBLIC WORKS by H. H. Hatch, engineer in charge of construction. The details of design and the methods of construction of this hydraulic fill structure should be of great value and interest to hydraulic engineers. In this issue we are presenting similar information concerning another great dam—the Saluda dam, which is of semi-hydraulic construction.

The hydraulic-fill is undoubtedly the safest type of earth dam for high structures, but there is still a good deal to be learned about this type before construction practice can be standardized. Mr. Hatch has shown that the fineness and character of materials in the core, and its width, can be controlled almost exactly, but just what fineness and characteristics the material should have is not so certain. If it is too fine, the core will not dry out; if too coarse, it is not impervious enough. Somewhere lies the desirable mean. The studies being carried on at Cobble Mountain should throw valuable light on this subject.

Perhaps these studies also may yield information applicable to the construction of levees by the hydraulic fill process, which so far, at least, has shown few advantages, if any, over dry fill construction. Many times, in dam construction, there will be a wide choice of materials for the fill, and, if necessary, materials from different pits can be mixed in proper proportions. But such is not the case on the Mississippi, where, for the most part, the constructor must take what nature has provided in the near vicinity. The result has been that, with the limitations on the settling pool imposed by the size of the levee, uniform placing of materials is not possible, and the return flow carries an excessive proportion of solids. In addition, the cost of bringing the hydraulic fill levee to the proper section is proportionately heavy.

Important Features in Swimming Pool Design

Most, though not all, health officers say that swimming pools are not important in the spread of communicable disease. Possibly this is true in the case of pools which do not carry any heavy bathing load, but where the number of bathers is excessive, skin and ear troubles develop in a distressing proportion of patrons.

A residual chlorine content is, of course, a prime safeguard, but to be effective the chlorine must be distributed throughout the cross-section of the pool. Relatively few of our present swimming pools, even the better ones, are so designed as to accomplish this important requirement. In practically none of the natural pools is it done. Around every large city are a number of swimming pools made by throwing a dam across a small stream. In these, even though chlorine is applied so heavily as to be the cause of discomfort to swimmers in the channel, very small protection is afforded to the many in the shallow waters along the shore, and most of these are children.

Detroit has secured about the best results in control of swimming pools, but in a number of cases chlorine has had to be applied throughout the pool. In one of the most modern swimming pools in Birmingham, which is 80 by 240 feet, it has never been possible to secure consistently good samples throughout the pool, even though a residual of 0.5 ppm. was set as the standard, because all water entered at one point, and there were undoubtedly a number of dead areas.

Better design, so that the requirements for residual chlorine can be met at any place in the pool, and a stricter application of good practice in operating, are much needed in this important and growing field.

America Can Learn From Holland

Holland, from a physico-geographical standpoint, is a unique country, taken as a whole, but most of the conditions found there exist in small areas elsewhere in the world; consequently, physical laws discovered there and methods of utilizing them which have been developed by vital necessity may be studied to advantage in connection with the development of similar, though much smaller, areas elsewhere.

The description in this issue of how that country has developed its water resources contains many points which should interest engineers and public officials in this country. Conditions in her sand dunes where fresh water extends to a depth of three hundred feet or more, find partial duplication in sand dunes along the coast of Mexico and near San Francisco, and on Long Island. Holland has learned that such supplies must not be used beyond their regenerative capacity, for if the underlying salt water once rises because of removal of the fresh, it may take many years to remove the salinity from the soil and restore the sweetness of the water.

Having no hills on which to place reservoirs, numerous standpipes or elevated tanks are necessary. The people are naturally artistic—what other country with a population about that of New York's has produced so many "old masters," or so widely affected art, from oil paintings to china ware? It is therefore natural that they should refuse to accept the stark ugliness of the standpipe as so generally found in this country and should endeavor to make it instead an ornamental feature of the landscape. Four illustrations of such attempts are depicted in the article.

Joint water projects are becoming more or less common in this country, but they are generally effected by the organization of not more than six to ten communities of fairly good size. In Holland we find one "water district" of 104 small communities, another of 40, others of 25 and less—at least a dozen such districts, most of them organized during the past ten years. Not only does the government encourage these, but it gives them direct aid by the making of investigations and plans, supervision of costruction, and even subsidizing of the projects. Possibly the necessity of universal cooperation of the entire people to protect their country from inundation has made such joint undertakings more natural to the Dutch than to most other nations.

Public Utility Relations

Use of psychology in billing and collecting so as to maintain the good will of the customer. Methods employed at Gladstone

By F. R. Buechner

City Manager of Gladstone, Michigan

THE human aspect of public service must be given its true weight as a factor in public management. Well may we subscribe to the ethical principle: "Our business standards shall have in them a tone of human understanding." There is no more practical and effective agency of good will.

The field of utility management offers the greatest opportunity for the most frequent and direct personal contacts with the citizen. It is significant that most of the customers are taxpayers, particularly in the small town. The value of the "satisfied customer" as a good will agent cannot be questioned. It is not enough that we provide adequate service twenty-four hours of the day, 365 days of the year. That is taken for granted. Our billing, collecting and credit adjustment services must be sound. Their effectiveness must not savor of any "public be damned" attitude. They must be tempered with sound human policy.

After several years' experience we have evolved the following methods which, while not in line with general practice, have proven practicable in minimizing ill-will and in materially improving collections.

Electric bills are mailed and charged to the consumer receiving the service. The printed form of the bill is perforated so that the stub may be detached at the time of billing and filed alphabetically in the office for collection purposes. Both portions indicate, in writing, the amount of arrears, if any, and the current amount. The portion sent the consumer varies in that it bears the regulation: "All bills are payable on or before the 21st."

On all bills having an arrears charge, a small red rubber stamp with a directing hand toward the arrears is used, bearing the following warning: "Unless satisfactory arrangements are made on or before the 15th day of the current month, service will be discontinued without further notice and $2.00 charged for cost of renewal." As a matter of fact, few enforced shut-offs are made until a personal notice is given on the premises by the shut-off agent. However, no other *written* notices are given the consumer. This rubber stamp method is nothing more than a rubber stamp, so far as the habitual delinquents are concerned, but it *does* jog the memory of the careless but honest type, and permits special consideration of the honest but poor type. Each detached bill stub in the "live file," having an arrears charge, is clipped at the top edge with a small clip. The manager may thus readily determine the number and character of the delinquents at all times, thereby eliminating thumbing through hundreds of ledger accounts and continually preparing and crediting delinquent lists. Moreover, the delinquent consumer who happens to pay shortly after such a list is delivered to the shut-off agent may have a *real* grievance.

The *water utility* follows the same billing process, except that water bills, by local custom, are charged and billed to the property owners. With the exception of three or four metered consumers, the water charges are all based on a semi-scientific flat rate schedule. The bills are conveniently compiled from a loose card inventory system, indicating the basic charge and the fixture charges against each lot and block. Unlike the electric meter bills, they are payable in advance quarterly, on or before the 21st.

The adoption of the "live file" system, containing a visible identification of the delinquents, obviates the necessity of impersonal collection methods. When payments are made in person or by check, in full of the account, the cashier merely removes the bill stub, stamps it paid and reserves it for making up cash. Partial payments and the date are recorded on the stubs. These are left in the "live file," and duplicate slips prepared for making up cash. The "live file" therefore, represents at any time the accounts receivable balance.

This system, among other distinct advantages, enables the manager to give personal and individual treatment in the collection of delinquent accounts. No shut-offs need be made without personal authorization.

Occasionally a survey is made of the "live file" and enforced shut-off forms filled out. These are served in person by a tactful city employee, with instructions to collect a certain amount or service will be discontinued. Hasty interviews result but the manager soon learns to diagnose the various types and the most successful method of treatment for each. No uniform method is followed. The actual number of necessary shut-offs has been less than 5% of the personal notices served.

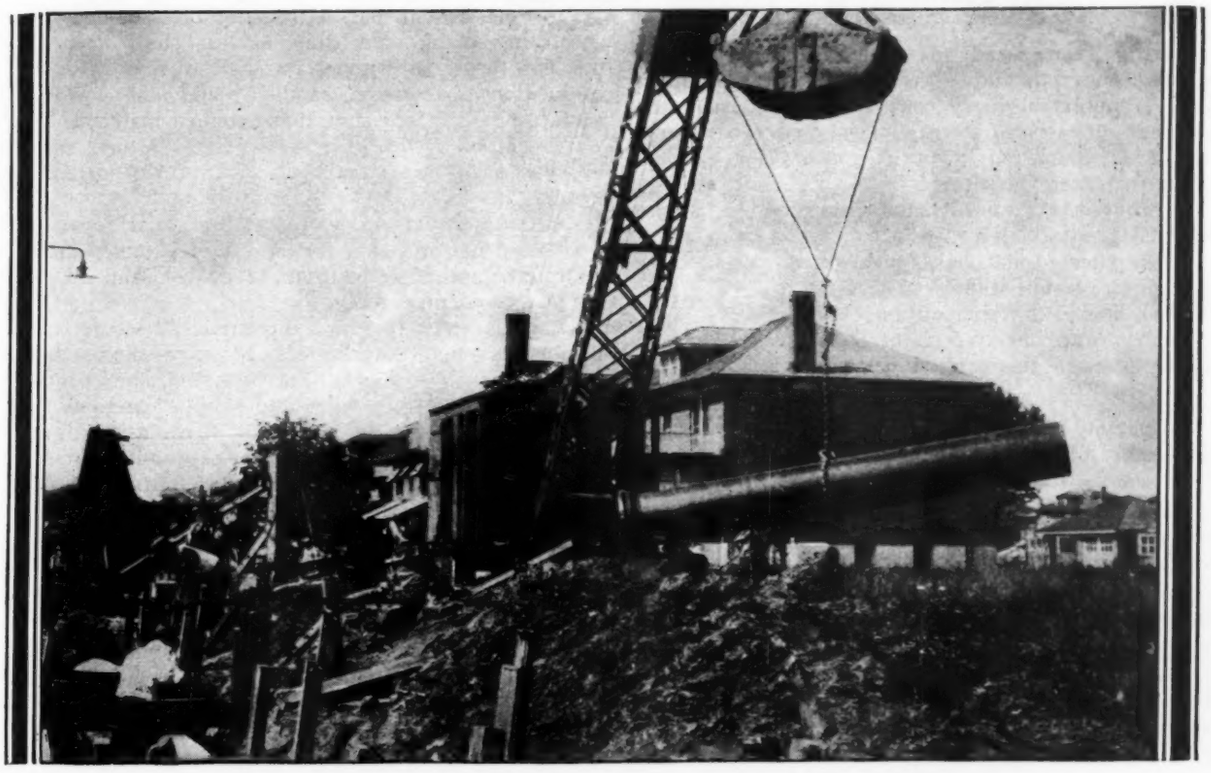
Experience will show that utility consumers fall in certain fairly definite classes. There are other types, in addition to the habitual delinquent consumer upon whom pressure must be exerted, and the honest but poor consumer who must be given extra credit or charitable aid. A leading water-works official very properly includes in the classification, "that fairly large group of law abiding, responsible consumers who through carelessness, indifference, self-importance or some personal idiosyncrasy, allow their bills to lapse." Sometimes a tactful personal reminder or simply a phone call will bring results. Obviously, here it is best to depart from the practice of personal shut-off notices. These methods have resulted in the reduction of the average amount delinquent, in the water utility alone, of from 20% to less than 5% of the total sales.

Nowhere in the whole realm of municipal management does the cultivation of human psychology by the manager and his staff become so valuable an asset as in the relations with the consumer. Care must be taken therefore, in the selection of capable employees who have had public office experience, who can stand criticism, rise above abuse, be firm but gentle, and yet be of a pleasant courteous nature. Clerks of this character are able to iron out many of the complaints of "high bills" by explanation and review of the customer's account over a long period of time, thereby reducing the number of meter tests and compromise adjustments.

Requests for credit adjustments in the "flat rate" water system, for vacancies, frozen water services, or other impairment of service form a universal source of annoyance and unwarranted expense. By changing from a six months to a quarterly billing period, the number of credit requests were greatly reduced in Gladstone. They were further reduced by adoption of the rule that "no credit shall be given except where written application has been made for the

(*Continued on page 70*)

No more storm drainage troubles for this progressive town



Installing storm drainage sewer, Lawrence, N. Y. Chas. F. Giraud & James M. Welach, Inc., Engineers. Del Balso & Sprague Inc., Contractors

NO longer are the streets of Lawrence, Long Island deluged to overflowing by heavy rains. No longer are citizens harassed by flooded cellars and undermined buildings. An adequate storm drainage system built with U. S. Cast Iron Pipe has solved the problem once and for all.

After a careful analysis of soil conditions, cast iron was specified because of its recognized high resistance to corrosion. The engineers and town officials agreed that over a period of years, long-lived cast iron pipe would be by far the most economical and efficient.

Hundreds of towns and cities have made similar decisions in favor of U. S. Cast Iron Pipe. In every state of the Union, withstanding every soil condition, you will find U. S. Cast Iron Pipe being used for drainage and sanitary sewers, as well as for culverts, gas lines, water lines and industrial installations.

Let us tell you more concerning the advantages of specifying United States Cast Iron Pipe.

Also inquire about deLavaud Pipe which is centrifugally cast for greater strength and greater carrying capacity.

United States Pipe and Foundry Co., Burlington, N.J.

Our pipe bears the "Q-Check" trademark of The Cast Iron Pipe Research Association

Sales Offices: New York, Philadelphia, Pittsburgh, Cleveland, Buffalo, Chicago, Dallas, Birmingham, Kansas City, Minneapolis, Seattle, San Francisco, Los Angeles

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Patented Materials in Highway Construction

Very few states or counties forbid the use of patented materials, but some require competition with unpatented ones in receiving bids

Having been asked to what extent the use of patented materials and processes is permitted or practiced in public highway construction, we asked the engineer of each of the state highway departments and several hundred county engineers for answers to the following questions:

Do your specifications make provision for the use of patented materials?

When patented material is involved, do you in every case require competition?

If so, how is this competition provided?

Replies were received from 566 counties and 45 states, and are summarized below.

Use by States

No patented materials are used by Iowa, Louisiana, Mississippi, South Carolina and Wyoming. They have been used in only four instances in Rhode Island.

Mississippi reports: "The present laws do not permit us to use patented pavements or pavements upon which royalties are paid directly or indirectly."

South Carolina reports that the specifications of the highway department "practically exclude the use of patented materials on its construction work."

Several states do not specify patented materials by their trade names, but permit them when bid on by contractors. These include Massachusetts and Oregon, and probably several others.

Competition—Twenty-one states reply that competition is always required, and three that it generally is. The remaining replies are indefinite on this point or fail to make any statement.

Competition is provided by receiving alternate bids on "other types" in six states; on "unpatented materials" in eight states; by "alternate bids" in five states. Bids are received on any material that meets the specifications in five states.

When a patented material or process is named in the specifications, Michigan also specifies two or more alternatives; North Dakota, for minor articles, uses the words "or equal," "or equivalent;" Texas specifies alternates, usually not patented.

In New Jersey competition is obtained by "naming in the specifications one or more equivalent types of construction upon which no patent exists, or upon which there is no proprietary right or condition, as an alternate type."

Illinois statutes provide that "any article, material or process covered by Letters Patent granted by the United States government may be specified and used for constructing or maintaining any proposed public highway, road or street or section thereof built by the state or by any county, city, town, village, township or district: Provided that said specifications are drawn so as to provide for an alternative method or methods of construction so that competition may be had between different types of material answering the same purpose."

As a general reply to our inquiry concerning the use of patented materials, several informants quote a paragraph of the specifications whereby the contractor must effect a legal agreement with the patentee or owner, or with his surety, to "indemnify and save harmless the party of the first part from any and all claims for infringement." This is assumed to imply that patented materials are or may be used, but does not give any information as to competition.

Use by Counties

Of the 566 counties replying, 438 report "no" to the first question; but the majority of these apparently permit the use of patented materials although not specifying them. Probably at least half have no occasion to use such materials, their road work being confined to dirt, gravel, sand-clay and other low-cost surfaces. Only four state that patented materials are not permitted. Thirty-three explain that their roads are not such as to call for the use of patented materials.

Of the remainder, who report that their specifications do make provision for the use of patented materials, 88 require competition, 12 do not, and 28 did not give a definite reply.

Of those which require competition, 20 secure it by asking bids upon alternatives, 10 others receive bids upon materials "equal to" that specified, one "similar to," one of "the same value and results," and one "as nearly equal value as possible." Five ask bids on unpatented alternatives. Two accept any material meeting the specifications. Three require manufacturers to fix one price for all bidders, and one seeks competition among contractors licensed to use the patented material specified. The remaining 44 simply state that they secure competition by receiving bids.

Brick Pavement on Steel Base

A short experimental section of pavement of unusual construction is to be laid on one of the highways of Sangamon County, Illinois, according to information furnished by the National Paving Brick Manufacturers Association.

On this test section the base construction will be entirely of steel and the wearing course of paving brick filled with asphalt. It is planned to use both plain and corrugated metal sheets, with curbs and stiffeners of various designs. This steel base will rest on a carefully prepared and rolled sub-grade and the vitrified brick will be laid on a bedding course of bituminous-sand mastic.

If the test proves that the pavement structure is successful under traffic, it is claimed that it possesses the following advantages: It will be essentially a factory-made pavement, with uncertainties due to the personal factor of field manipulation practically eliminated; it will be flexible throughout and there will be an absence of cracking as well as permanent deformation under traffic; by using rust-resisting materials and treatment, durability can be secured. If there is a demand for this type, there is no question but that the initial cost will be comparable to other high-type designs.

Permission to construct the test section has been given by the Illinois Division of Highways, Frank T. Sheets, chief highway engineer, and it will be constructed under the supervision of Truman L. Platt, superintendent of highways in Sangamon County. The steel will be furnished by the American Rolling Mills Company, manufacturers of Armco Ingot Iron, and the brick by the Poston-Springfield Brick Co. of Springfield, Illinois. The National Paving Brick Manufacturers Association, G. F. Schlesinger, chief engineer, Washington, D. C., is co-operating in the test.

For the Good *of* Contracting

In every business it's the irresponsible, short-sighted competition that's destructive both to itself and others.

The contractor who bids to get the job rather than make a profit, who is operating without sufficient capital or experience, hurts the competent contractor and the man who pays the bills — the taxpayer.

That's why — for the good of contracting — N. E. C. even at the loss of sales will not join in unethical sales policies and practices or unreasonable terms certain to encourage destructive competition.

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KOEHRING
Pavers, Mixers; Power Shovels, Pull Shovels, Cranes, Draglines; Dumptors.

INSLEY
Excavators; Concrete Placing Equipment, Cars, Buckets, Derricks.

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T. L. SMITH
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KWIK-MIX
Mixers: Concrete, Plaster and Mortar.

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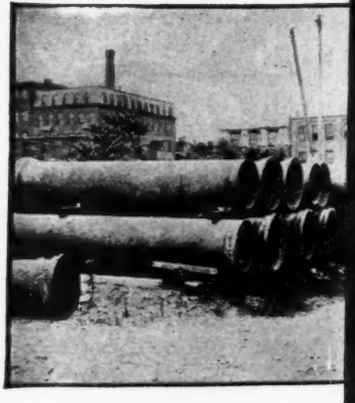
IN BOSTON . . . original cast iron water mains are still in service after 83 Years . . . . .

Fairchild Aerial Survey, Inc., N. Y.

CAST iron water mains which were put down way back in 1847 are still on duty in the City of Boston. A splendid record, and convincing, but by no means exceptional for cast iron pipe. Many cities in all parts of the country can point to cast iron mains still in use after as long, or even longer, service.

The superior durability of cast iron pipe is due to its high resistance to rust and corrosion. Gas and water mains of ferrous metal (iron and steel) with the exception of cast iron, disintegrate from rust. Cast iron pipe is the only ferrous metal pipe practicable for underground mains which rust will not destroy.

Engineers, contractors and city officials desiring information on the use of cast iron pipe for gas, water, sewers, road culverts or industrial needs should write to The Cast Iron Pipe Research Association, Thomas F. Wolfe, Research Engineer. People's Gas Building, Chicago, Ill.



This cast iron pipe, after 37 years service was found to be in perfect condition. Relaid in new location.

The "Q-check" symbol shown above has been adopted as the trade mark of The Cast Iron Pipe Research Association.

Cast iron pipe bearing the "Q-Check" trade mark is obtainable from the following leading pipe founders: Alabama Pipe Company, Anniston, Ala.; American Cast Iron Pipe Company, Birmingham, Ala.; James B. Clow & Sons, 219 N. Talman Avenue, Chicago, Ill.; Donaldson Iron Company, Emaus, Pa.; Glamorgan Pipe and Foundry Company, Lynchburg, Va.; Lynchburg Foundry Company, Lynchburg, Va.; National Cast Iron Pipe Company, Birmingham, Ala.; United States Pipe and Foundry Company, Burlington, N. J.; Warren Foundry and Pipe Company, 11 Broadway, New York.

CAST IRON PIPE

Toronto Department of Street Cleaning

Organization of more than a thousand employees for cleaning streets and collecting and disposing of refuse. Garbage incinerated. Land for ash and rubbish dumps becoming scarce

THE Department of Street Cleaning of Toronto has charge of the cleaning of the public thoroughfares and catch basins, and the collection and disposal of the refuse of that city of six hundred thousand people.

The organization is primarily divided geographically into three parts, the division superintendent of each having charge of the street cleaning and refuse collection in his section; while a fourth superintendent has charge of the three refuse disposal plants and the garage. Each geographical division is divided into several "foremen's districts" (24 in all), and each of these into three sections to allow for three collections a week. The whole department is in charge of a street commissioner and a deputy commissioner. George W. Dies is, and for several years has been, street commissioner.

During 1929 an average of 1,055 men were employed by the department, of which 195 were street cleaning patrolmen and 102 were engaged continuously at the refuse disposal plants. The refuse collection service employed 35 city-owned trucks, 374 city-owned wagons and 80 hired carts during the peak of the season, reduced to 25 trucks, 337 wagons and 28 hired carts during the summer. It maintained 384 horses in its several stables.

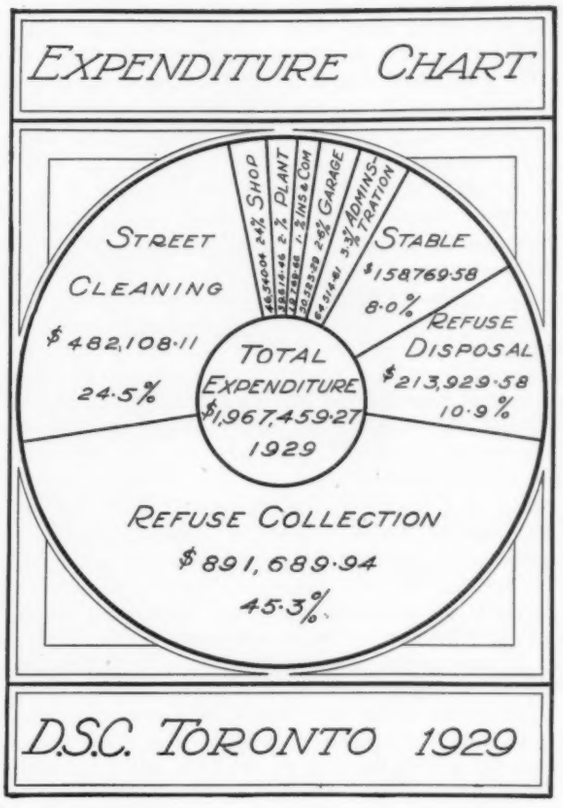
The services rendered included cleaning 571 miles of streets, of which 506 were paved with 8,137,816 sq. yds. of asphalt, bitulithic, brick, cement concrete and asphaltic concrete; cleaning 51,146 catchbasins; oiling 197 miles of road; collecting 252,216 tons of ashes and other incombustible refuse and 159,153 tons of garbage and combustible refuse from 126,682 buildings, and burning 141,734 tons in three incinerators, the remaining 17,419 tons being dumped because of insufficient capacity of the incinerators.

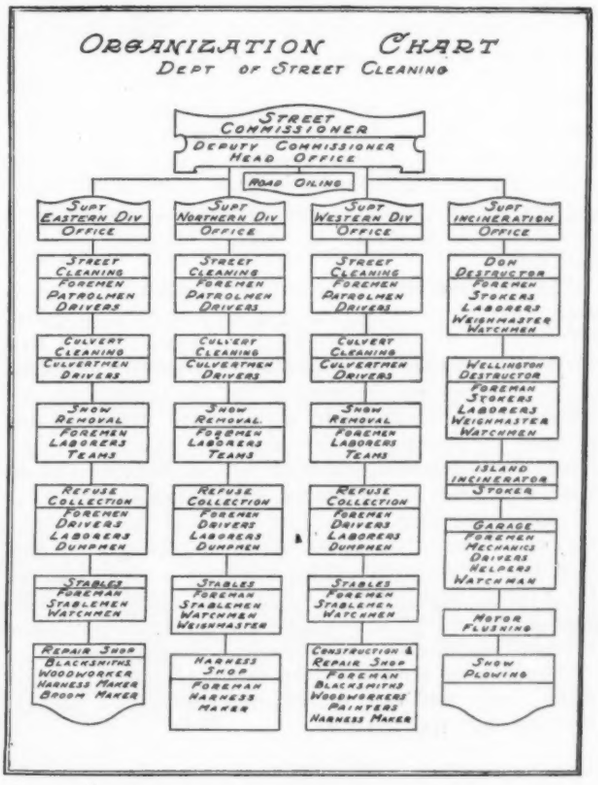
The total expenditure of the department was $1,967,459; of which (distributing overhead and general expenses) 30.4% was for street cleaning, 56.2% for refuse collection, and 13.4% was for refuse disposal. Of the total $1,562,371 was paid directly as wages.

The patrol system is used entirely in the downtown section and on main thoroughfares. Each patrolman maintains an average of three miles of streets, which is considered to be far in excess of what he can maintain properly. The cost of this service per 1,000 sq. yds. per season was $33.23, or $2.73 per cubic yard swept, collected and removed. Average cost of cleaning 1,000 sq. yds. once, 36.9 cents.

The department has eight flushers, but last year used but three of them because of insufficient funds; although it believes that "flushing is the best means of removing the fine dust that escapes the patrolman's broom"; "it is a very essential service" and "it is anticipated that a regular flushing schedule will be adopted for the coming season." The cost last year of flushing 2,740 miles, or 67,130,000 sq. yds. of street, using 15,229,000 gallons of water, was $8,428, or $3.07 per mile.

The cost of collecting combustible and non-combustible refuse averaged 9 cents per collection per




ORGANIZATION CHART
DEPT OF STREET CLEANING
STREET COMMISSIONER
DEPUTY COMMISSIONER
HEAD OFFICE
ROAD OILING
SUPT EASTERN DIV OFFICE
SUPT NORTHERN DIV OFFICE
SUPT WESTERN DIV OFFICE
SUPT INCINERATION OFFICE
STREET CLEANING FOREMEN PATROLMEN DRIVERS
CULVERT CLEANING CULVERTMEN DRIVERS
SNOW REMOVAL FOREMEN LABORERS TEAMS
REFUSE COLLECTION FOREMEN DRIVERS LABORERS DUMPMEN
STABLES FOREMAN STABLEMEN WATCHMEN
REPAIR SHOP BLACKSMITHS WOODWORKER HARNESS MAKER BROOM MAKER
HARNESS SHOP FOREMAN HARNESS MAKER
STABLES FOREMAN STABLEMEN WATCHMEN WEIGHMASTER
CONSTRUCTION & REPAIR SHOP FOREMAN BLACKSMITHS WOODWORKERS PAINTERS HARNESS MAKER
DON DESTRUCTOR FOREMEN STOKERS LABORERS WEIGHMASTER WATCHMEN
WELLINGTON DESTRUCTOR FOREMAN STOKERS LABORERS WEIGHMASTER WATCHMEN
ISLAND INCINERATOR STOKER
GARAGE FOREMEN MECHANICS DRIVERS HELPERS WATCHMAN
MOTOR FLUSHING
SNOW PLOWING

Organization Chart, Toronto Department of Street Cleaning

building, $2.09 per ton, $9.51 per building per year or $1.99 per capita per year; this including hauling to place of disposal, administration, insurance, stable, repairs and upkeep.

As stated above, a maximum of 489 vehicles were used in collection, reduced to 390 in the summer. The gradual motorization of the service has reduced the number of hired carts from 200 in 1925 to 80 in 1929. These 1½ yard carts were satisfactory when hauls were short, but are no longer so where the hauls are greatly lengthened due to scarcity of dumping places.

In the outlying districts 107 trailers are used, horse-drawn while being loaded, and drawn to incinerators in trains of two to four by motor trucks. They have a capacity of 6 cu. yds. water level, or 8 to 10 yards with staked sides.

The cost of incineration was $1.38 per ton at the Don Destructor and $1.10 at the Wellington Destructor. The former has been in service since 1917, has a guaranteed capacity of 180 tons in 24 hours but destroys an average of 200 tons in 16 hours. The latter destructor has been in service since 1925, has a guaranteed capacity of 400 tons in 24 hours but has destroyed 350 to 400 tons in 16 hours. Of the costs at the two plants, $1.23 is for labor at the Don and 98 cents at the Wellington.

"It is now universally established," said Mr. Dies in his annual report, "that the proper plan for the disposal of organic and vegetable waste is to destroy it by fire, and not to attempt to use it for hog feed, burying it for manurial purposes, or making any attempt at reduction. The stench which emanates from any of these three methods is a menace to the public health of any neighborhood, and highly unsatisfactory.

"The problem that now faces the larger municipalities is that of the disposal of ashes and incombustible refuse for which there is no solution, other than that of land fill.

"If such fills are properly supervised and kept free of all organic and vegetable matter, they may be conducted without creating a nuisance.

"Unfortunately, at the present time, Toronto has not sufficient destructors to destroy all combustible refuse, and a percentage of it must be incorporated in ash and rubbish fills. The presence of this matter has repeatedly created a public menace, particularly during the summer months, necessitating the discontinuance of the dump and the seeking of more isolated locations.

"If sufficient destructor accommodation was available, with the necessary margin of flexibility in order that repairs to furnace could be effected without diversion of garbage to land fills, it would be possible to enforce a closer observance of the separation of garbage and combustible material at the point of primary collection, thereby making it possible to destroy all combustible refuse by incineration, then land fills could be conducted without nuisance.

"The increasing scarcity of available land suitable for the disposal of ashes, street sweepings, culvert cleanings, and incombustible material is very acute at the present time, and it is a matter of only a short time before it will be necessary to acquire ravine lands beyond the city limits for dumping places."

The cost of upkeep of the dumps (almost entirely labor) was $40,481, or 16 cents a ton of incombustible material dumped.

Prequalification Results by the Bureau of Public Roads

THE forest road work and the National Park road work are carried on directly by the Bureau of Public Roads through contractors, and in this work the bureau has for three years prequalified the contractors. In 1928 there were 193 applications for prequalification and 189 qualified. In 1929 there were 276 applications for qualification blanks and 262 qualified. So in two years only 18 applicants, or less than 4 per cent, were refused qualification.

Commenting on this, Thomas H. MacDonald said: "The truly wholesome effect of this qualification of bidders seems to be that the man who is not financially qualified or properly equipped to conduct a contract comes to that realization when he quietly faces one of the prequalification blanks before he has put in a low bid. In the old days the awakening came sometimes after making the low bid.

"So the important point to prequalification is that the man who would bid upon work faces the issue of responsibility before, and not after he has put in his bid. This seems to be all of the limitation of competition that is involved.

"With this record, I believe *no one can truthfully say that prequalification limits competition.* There can be no competition that is of advantage to the public when inefficiency with inadequate equipment and inadequate financial resources is placed in competition with efficiency, adequate equipment and financial responsibility. The public would never benefit from competition of inefficiency with efficiency and the awarding of work to the inefficient contractor rather than the contractor who can and does satisfactorily perform his undertaking."

After prequalifying contractors began, the bureau received 470 bids in 1928 and 393 in 1929. The average number of bidders at each letting in 1928 was 4.7, and in 1929, 5.4. In other words, an average of five contractors bid for each job in each of the two years. There was only one default in each of the two years. But in 1926, the first year preceding prequalification, there were six defaults.

These facts seem to Mr. MacDonald to be conclusive arguments in favor of prequalification.

Handling Hot Asphalt With a Belt Conveyor

A mixture of asphalt, sand and stone screenings, at a temperature of 200 degrees Fahrenheit, is handled by portable conveyors from an asphalt plant direct into railroad cars or onto a curved stock pile, at the Western Asphalt Paving Company plants at Richmond, Virginia and Lancaster, Pa.

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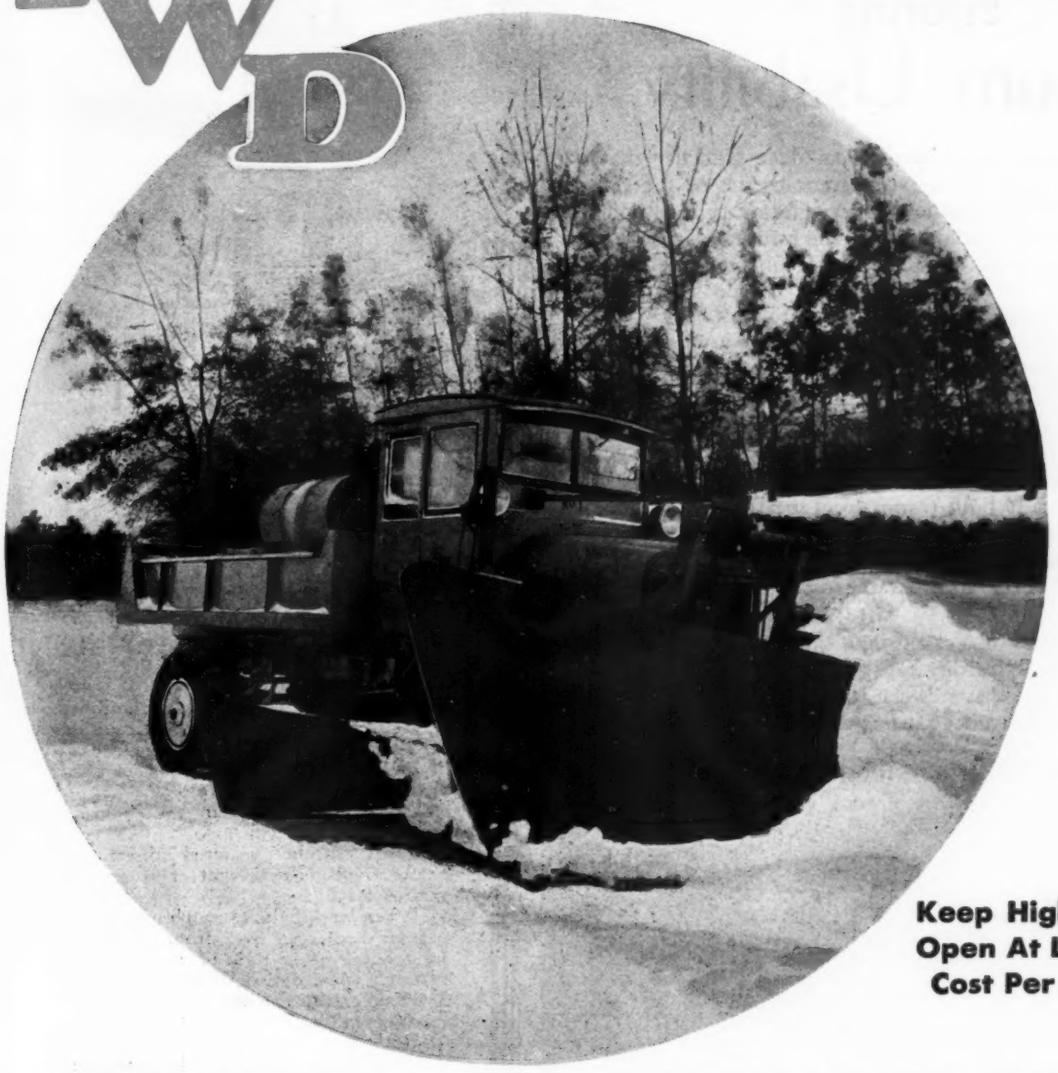
The loading of cars and storing of the material would have been too costly to do with wheelbarrows. On the other hand, the volume was too small to justify a derrick, or a crane with a clam shell bucket which would mean an operator idle most of the day.

FWD MORE than a Truck



FEATURES

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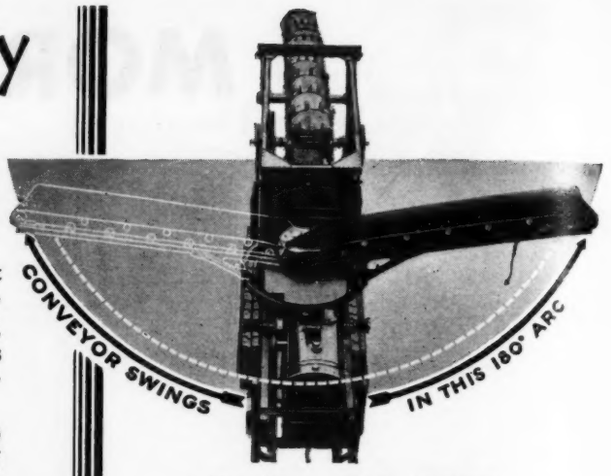

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Economics of Highway Design*

Considered under the general heads of location, alignment and grade, width and cross-section, soil classification and subgrade analysis, and types of surfacing. Pleasure riders should be considered

By A. G. Bruce

Senior Highway Engineer, Bureau of Public Roads

THE principles of economics have a direct influence on nearly every phase of highway design because practically every step in highway improvement is for the purpose of producing, distributing and consuming wealth, or to furnish the material means for satisfying human desires. It is not always advisable, however, to apply economic principles too narrowly in the design of our highways because if we attempt to reduce transportation costs to the absolute minimum we may unduly restrict the number of miles of road that should be built per year, and until a much larger percentage of our highways is improved we are justified in compromising somewhat in some of the refinements of design, in order to have funds for more miles of serviceable roads. It may be possible to prove by economics that rigid pavements 12 inches thick provide the necessary factor of safety against over-stress from impact; but with less than 25 per cent of our state highway system paved, it is hardly feasible to attempt such concentration of public funds.

There is also to be considered the fact that a large percentage of the road users are not commercial carriers, and that the same economic principles that govern railroad design are not applicable in most cases to our highways. A straight line is the shortest distance between two points, and the operation cost per vehicle would, generally speaking, be the lowest on long tangents, but a gently curving road of slightly greater length may be so much more satisfying to the majority of the road users that we are justified in the compromise except where the percentage of commercial carriers is unusually high. This should not be construed as an argument against the application of economic principles to highway design, but only as a warning against too narrow an application of economics without due regard for other important considerations.

In considering the subject of highway design economics, the following points will be developed:

Location.
Alignment and grade.
Width and cross-section.
Soil classification and subgrade analysis.
Types of surfacing.

LOCATION

Before it is possible to determine where our major highways should be located, it is necessary to know the nature and volume of the traffic which will use the highways. To obtain this information, it is necessary to make a traffic survey of the area under consideration in order to determine the volume of each type of traffic; its points of origin and destination; the weight and variety of materials transported; the ratio of loaded trucks to total traffic; the number and frequency of critically heavy loads; the traffic density including hourly, daily and seasonal variations; the obstructions to free flow of traffic and the time lost at each; the relative traffic-carrying capacities of highways of various widths, and the density and distribution of population with special emphasis on industrial growth and trends.

From the information developed by the traffic survey, the highway routes may be classified according to traffic requirements and located to best serve transportation needs. The layout of individual road projects must necessarily be governed to a great extent by local conditions and local developments. In sparsely settled areas new road locations may be developed with very little regard for existing road improvements, but in many sections of the country the lines of transportation have been so definitely established that the existing roads must be followed with such minor relocations as are necessary to provide reasonably adequate modern standards of highway design.

From the traffic surveys already made the following data have been developed:

1. That local traffic constitutes the larger part of the total traffic, through traffic falling as low in some areas as 2% and rising as high as 46% in some resort areas.
2. That truck traffic averages about 10% of the total traffic.
3. That only a small per cent of trucks carry loads in excess of 5 tons.
4. That state highways, although comprising but 10% of the total rural mileage, carry 80% of the total rural traffic.
5. That two-thirds of the passenger car trips are less than 60 miles and three-fourths of the motor truck trips are less than 30 miles.
6. That traffic on the rural highways is predominantly city-owned passenger cars and trucks.
7. That traffic is best served by an even number of traffic lanes.
8. That the normal traffic capacity of a two-lane road is about 10,000 vehicles per day, and the maximum volume per hour is attained when the speed is about 20 miles per hour.

ALIGNMENT AND GRADE

Alignment

Directness of alignment is an important consideration because distance and transportation costs are directly related. There are, however, two schools of thought in the matter of details of alignment. The economist demands the straightest road it is possible to secure consistent with reasonable construction costs, while the landscape engineer demands winding alignment along the natural contours of topography with a minimum of cutting and filling. The economist has transportation costs in mind, and the landscape engineer is chiefly concerned with appearances. It is the age old controversy between art and science, and the highway engineer must, by intelligent compromise, develop alignment that will be reasonably direct but with sufficient gentle curvature on natural contours to satisfy the demands of beauty on the part of the highway users.

The growing appreciation of natural beauty on the part of the general public is a factor not to be ignored in the design of our highways. The consideration of the aesthetic viewpoint requires that our rural highways be pleasing to the eye, and to this end the engineer is called upon to develop road locations so as to

*A lecture delivered before the Highway and Railway Division of the Civil Engineering Session of the Summer School for Engineering Teachers of the Society for the Promotion of Engineering Education at Yale University, July 18, 1930.

Highways should be located to take advantage of views such as this one of Donner Lake, Calif.

bring out the natural beauty of the localities, preserving the specimen trees, develop vistas of outstanding magnificence and design bridges and culverts and guard rail which will harmonize with the general character of the landscape. This appreciation of natural beauty is responsible for the greatly increased use of short tunnel and half-tunnel sections under picturesque overhanging cliffs and along precipitous canyon walls where formerly it was the practice to blast away these irreplaceable landmarks. The western states are considerably ahead of the east in this kind of construction, partly because the topography lends itself to the idea, partly because the commercial traffic is relatively small and tourist traffic relatively large. It is not easy to reconcile economics and beauty in the same highway, and the ultimate solution of the problem may be the development of two distinct types of roads, the express highway and the boulevard highway. The express highway could be designed in strict accordance with economic principles, the same as the railroad, and the boulevard highway in accordance with the best ideas of the landscape engineer and park expert.

Curves—At the present time the minimum radius of curves on most Federal Aid Projects is around 500 feet, although several states have adopted 1000 feet as standard construction. Most of the states using the 1000 foot minimum radius are located in the prairie sections, and it is not expected that such wide curves will become standard practice in the mountains or in the rugged sections of the east. Where long, easy curves are used, compound curves are not objectionable; but where the curves are of short radius, the reverse, compound and "broken back" curves are ordinarily unsuitable for modern fast motor traffic, especially at night.

All modern pavements are superelevated on curves of more than 1°, but the amount of such superelevation and the method of developing it vary considerably in the several States. The superelevation formula recommended by the American Association of State Highway Officials is

$$E = .067 - \frac{V^2}{R}$$

where E = the maximum superelevation in feet per foot of road width.

V = the velocity in miles per hour (35 recommended).

R = the radius of the curve in feet.

Short tunnel in Zion National Park

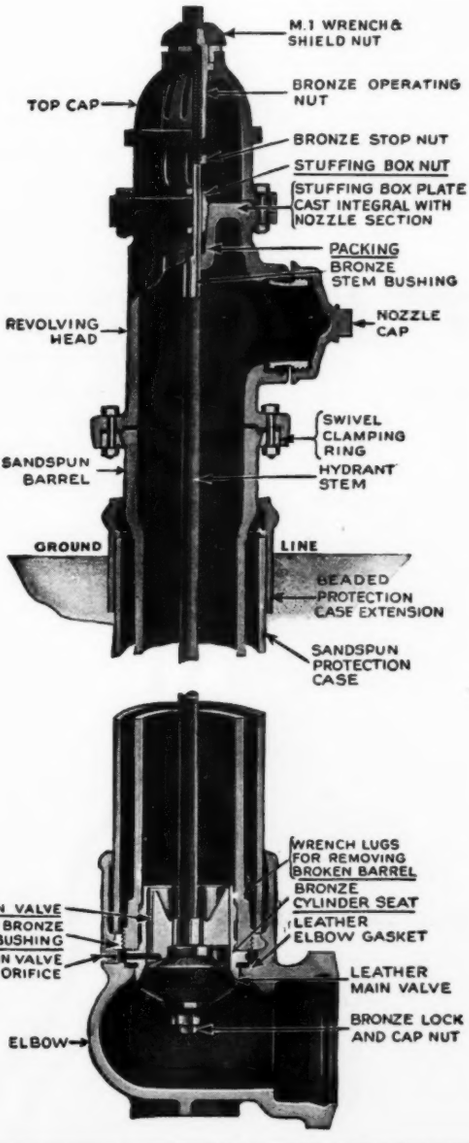
Masonry guard rail in Glacier National Park, Montana.

Damage to Hydrants

To the Editor:

We have had an epidemic of hydrants that were struck by trucks and automobiles, most of them at street intersections. The repairs have been most troublesome and even costly. Can you suggest some way by which the trouble can be reduced, if not eliminated?

Yours truly,
WATER WORKS ENGINEERING



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The maximum superelevation recommended by the American Association of State Highway Officials is one inch per foot of width, or about 20 inches for the usual two-lane road. This amount of superelevation appears somewhat conservative to some drivers of fast cars, but due to the great variety and speed of vehicles using the highway, and the extra hazard of ice in winter, it is the opinion of most highway engineers that one inch per foot superelevation is sufficient for the present.

Curves of more than 8° are usually widened. The most common formula used is

$$W = 2\left(R - \sqrt{R^2 - L^2} + \frac{35}{\sqrt{R}}\right)$$

where W = the widening in feet.
R = the radius of the curve in feet.
L = the wheel base of the vehicle (20 feet recommended.)

Compensated curve in Zion National Park

The majority of states start widening 75 feet to 100 feet ahead of the point of curvature and reach full widening in the same distance inside the curve.

(*Continued on page 61*)

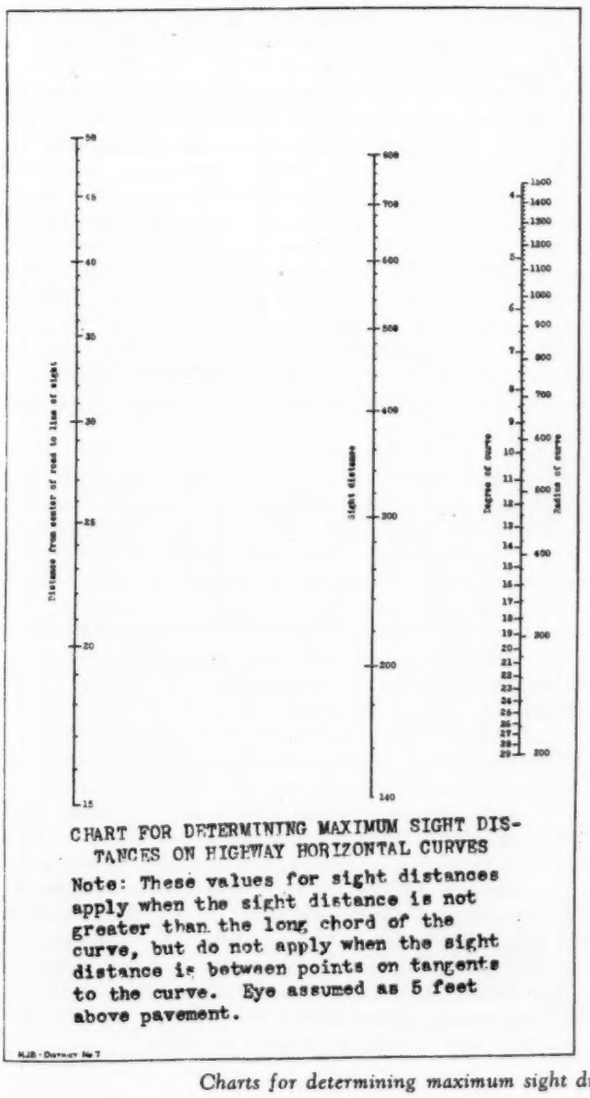
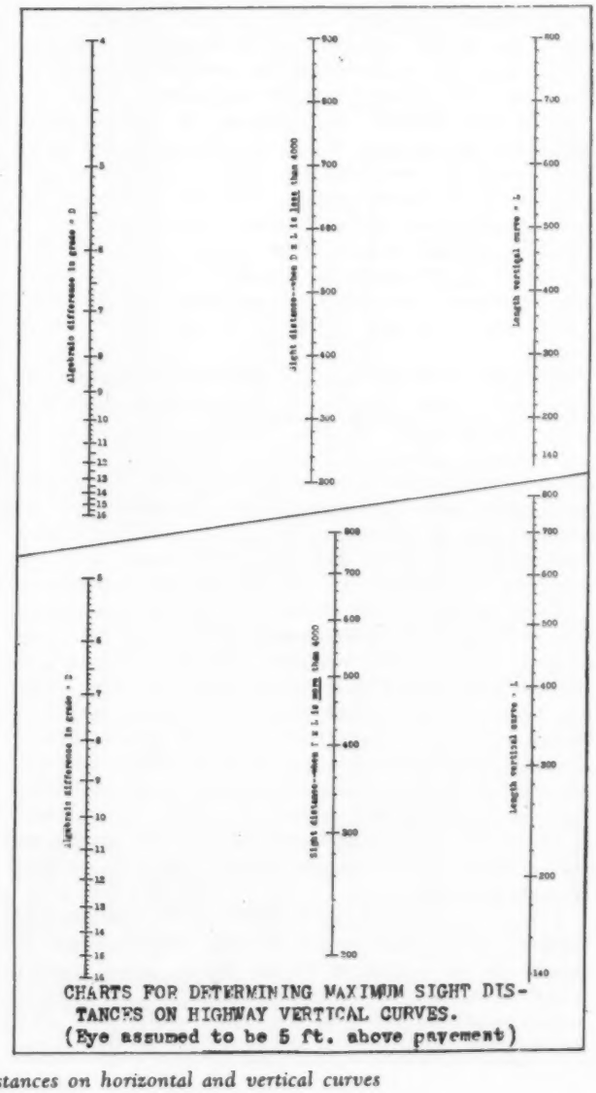


CHART FOR DETERMINING MAXIMUM SIGHT DISTANCES ON HIGHWAY HORIZONTAL CURVES

Note: These values for sight distances apply when the sight distance is not greater than the long chord of the curve, but do not apply when the sight distance is between points on tangents to the curve. Eye assumed as 5 feet above pavement.


Algebraic difference in grade = D
Sight distance—when D x L is less than 4000
Length vertical curve = L
Algebraic difference in grade = D
Sight distance—when D x L is more than 4000
Length vertical curve = L

CHARTS FOR DETERMINING MAXIMUM SIGHT DISTANCES ON HIGHWAY VERTICAL CURVES.
(Eye assumed to be 5 ft. above pavement)

Charts for determining maximum sight distances on horizontal and vertical curves

Present-Day Water Treatment Processes

Discussion of recent standard practice in clarifying, filtering and chlorinating water, with examples from Tennessee practice

By A. E. Clark
Associate Sanitary Engineer, Tenn. State Dept. Public Health

IN order to meet the demands of the consumers of water for a safe, palatable and otherwise satisfactory supply, the engineer must design a purification plant to treat the water in the way necessary for obtaining the desired results. For a number of years plants were designed along more or less empirical lines, but it has been found through experience that each water is a different problem. Also the majority of engineers today are giving more thought to economy of construction, location and operation. Many more experimental plants are now constructed and operated for a sufficient period of time to indicate definite conclusions in regard to the design of the full-scale plant, making concrete data available so that the engineer is in a position to design his structures knowing exactly what is needed as well as the results to be obtained.

Mixing Chambers. Practically no filtration plants are designed today without mixing chambers. There is difference of opinion between engineers regarding the relative merits of the mechanical and gravity types of mixing chambers. The majority of the larger plants are being designed with mechanical mixing devices and one with which the writer is familiar is designed with double mixing chambers. This provides a very flexible arrangement, as under certain conditions of the raw water double agitation seems most beneficial, while under other conditions single agitation gives better results. The raw water usually enters the bottom of the chamber tangentially and is taken off at the surface. The coagulant is added to the water as it enters the chamber. In many plants the revolving mechanism is operated by variable-speed motors, so the agitation of the water can be varied.

The smaller plants usually make use of the gravity type, with either vertical or horizontal baffles—both give equally good results. Some contend that the gravity type is just as flexible as the mechanical, because velocities can be changed by adding or taking out baffles; also that there is no additional cost for mixing, and the plants are free from much mechanical equipment. Velocities are fairly well established and usually vary between 0.5 and 2.0 feet per second.

There is also some controversy about the mixing time to be allowed, which varies all the way from two minutes to thirty-five minutes, although the majority fall between fifteen and twenty minutes. The writer has worked with a plant where the mixing period allowed was only two minutes and obviously little is accomplished; probably just as good results would be obtained if the coagulant was added to the raw water main and dependence placed on the agitation there, as the time interval between the low-lift pumps and the settling basins would about equal the mixing period provided.

Either type of mixing chamber, when properly designed, gives good results because finally much depends on the operation of the plant. Two identical plants treating the same water but under different supervision may not give the same results; and while the mixing chamber is only one part of the process of purification, much depends on the proper design and operation of it. There is no question but that more economical operation is obtained where a sufficient mixing time is available. The operator is in a much better position to take care of rapid changes in his raw water, because with a mixing period of say, twenty minutes, if he misses the proper dosage it is quickly found out; whereas without mixing, improper dosage is more difficult to detect in the sedimentation basins, with the result that many times a smoky or distinctly turbid water will pass the filters. This occurred frequently in the plants treating waters subject to rapid fluctuations before mixing chambers were considered essential parts of such plants.

Pre-settling. For waters which carry relatively high turbidities during the greater part of the year the use of pre-settling basins is usually very beneficial as well as economical. The time that can economically be given to pre-settling depends on the cost of construction of the basin, which indirectly is governed by the size of the plant. Many of the smaller plants can use pre-settling, whereas some of the larger ones find the cost prohibitive if the settling period allowed is sufficiently long to prove of value. The time allowed varies, some having retention periods of a day while others may provide a week or more for settling. The efficiency of the basins depends on the character of the suspended matter in the water. Obviously, suspended matter of high specific gravity settles out rather rapidly while that of a colloidal nature settles very slowly. Plain settling efficiencies are subject to many variables, depending on the design of the basins, retention time, character of the suspended matter and probably to some extent on temperature. With short retention periods and possibility of short circuiting, the efficiency of a basin may drop to zero, while under more favorable conditions it may increase to more than fifty per cent.

A small filtration plant (1 m.g.d. capacity) treating a river water which normally runs low turbidities had difficulty in producing a good effluent following rains on the watershed which produced high turbidities. The treatment plant was poorly designed, both the filters and sedimentation basin. A basin holding approximately three days' storage was constructed in hope that this would eliminate all the trouble, but it was found that even with this pre-settling period the water was not always satisfactory. A shallow mixing flume was next built along one wall of the basin and alum added to the raw water as it entered the flume. Conditions were helped considerably by this, although some trouble would still result following a prolonged wet spell. At the present time plans are being made to construct a mixing chamber where the raw water will be properly treated with coagulants before entering the pre-settling basin and further, another dry feed machine is to be installed so that the pre-settled water will receive a second dose of coagulant as it leaves this basin and before it reaches the sedimentation basin. A properly designed mixing chamber and sedimentation basin would be sufficient at this plant to treat any condition of the raw water.

Sixteen little points that loom BIG later

Water baffled above nozzles (6) insures constant smooth flow of water.

The stuffing box (4) is repacked from the top of the hydrant without unbolting the hydrant bonnet.

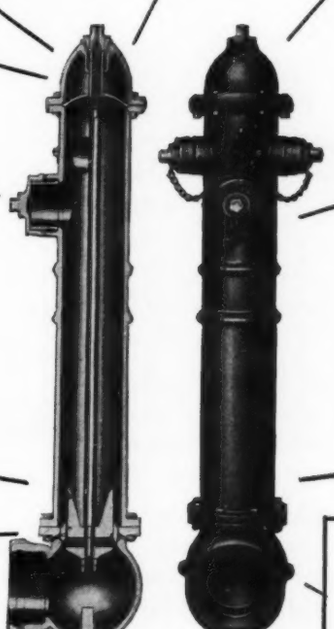
All working parts removable through the top of the hydrant without disturbing the hydrant barrel.

Working parts easily lubricated. Oil holes conveniently located and clearly marked.

Built in strict accordance with American Water Works Association specifications.

Hydrant barrel (22) of extra large diameter. Has no cross obstructions to impede the flow of water.

Broken hydrant barrel can be replaced without cutting the water off at the valve.



The drain (24) is automatic, dependable. No springs, cams, levers, toggle joints or synchronized screw adjustments to get out of order.

Specially treated drain valve leather, dovetailed and screwed, cannot possibly come out in service.

Should street levels be raised, hydrants can be lengthened easily and economically with our extension sections.

Metallic gasket forms positive water-tight joint and always comes out with the seat ring.

"Vim" leather valves. Three times the abrasive strength of any other leather. Water-proof, oil-proof, acid-proof. Heat-proof up to 300° F. Will last two or more times longer.

All bronze working parts machined to three thousandths inch, gauged and checked.

All working parts machined to permanent steel gauges, and are interchangeable.

A compression type hydrant — if the barrel is broken, no water is freed to flood the streets.

Tested to 300 pounds hydrostatic pressure. Certificate furnished on request.

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IRON WORKS
CHATTANOOGA, TENNESSEE

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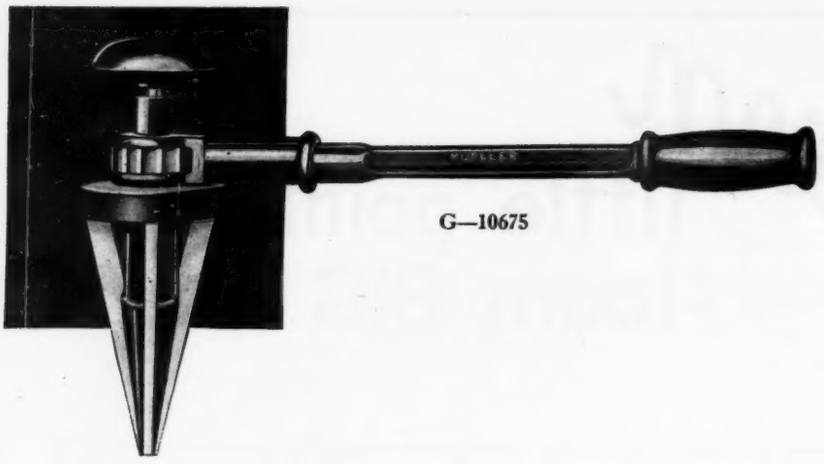

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Even the most skilled workman can't turn out an A-1 job if his tools are out of tune to his ability.

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Mueller tools are made for men with pride in the craft they follow. Nothing has been spared to make them the most efficient—the most durable and the most convenient to use. All metals come from tested batches from laboratory controlled sources. All forgings are done by hand in the same time-honored manner approved by centuries of experience.

The Pipe End Reamer and the Water or Gas Main Calking Set, illustrated, are typical of the highest type tools

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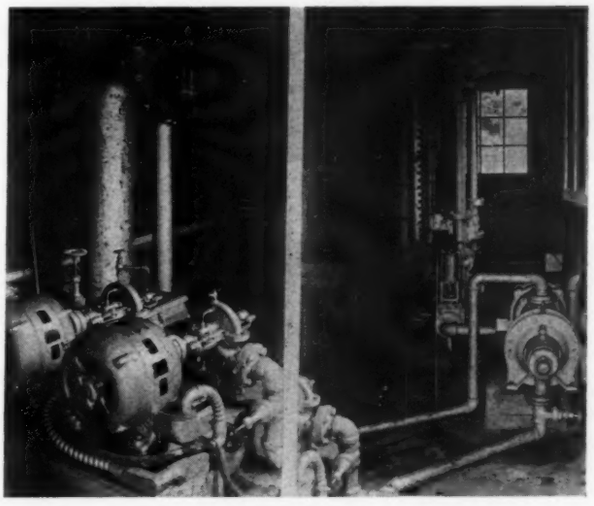
Hales Bar Plant

This plant, operated by the Tennessee Electric Power Co. to furnish water for its employees at the Hales Bar hydro-electric plant, has a capacity of 50,000 gallons a day. It is operated semi-automatically. Instead of a baffle or mechanical type of mixing chamber, compressed air is used for agitating the water. The settling basin is of the straight-flow-through type. The filter is circular, of wood stave construction. A loss-of-head gauge and filter controller are provided. The water is chlorinated.

The accompanying illustrations show the location of the plant upon a hill side, with attractive arboreal surroundings.

Sedimentation. Considerable study has been and is being given to proper pre-treatment of water. It has been found by experience that there is not any rule-of-thumb method that can be applied to the chemical treatment of all waters. Following the right pre-treatment, sedimentation in well-designed basins gives very high efficiencies. There are numerous examples of basins so designed that a great deal of efficiency is lost, possibly due to too short retention periods and high velocities, or with sufficient theoretical retention time but short-circuiting. The retention usually allowed for the average water approximates four hours. In the majority of cases a settling time of four hours with proper pre-treatment gives excellent results.



Hales Bar Plant

Filtered water storage is provided by two steel tanks, formerly used as oil storage tanks, having a combined capacity of 6,000 gallons. An orifice and float valve maintain the rate at 50,000 gallons a day. The plant runs continuously, and the filtered water pumps operate when necessary, being activated by a float switch located in the elevated storage tank. Wash water is obtained from a third steel tank. The cost of the plant complete was about $7,500. It was designed by the company's engineers and constructed by its employees.

Sedimentation basins rectangular in shape are generally designed with a ratio of length to width of 1½ or 2 to 1. Depths vary from twelve to eighteen feet, being somewhat dependent on the amount of sludge storage required, and this in turn on the character of the water being treated. On highly turbid waters or in softening plants, the tendency is toward mechanical clarifiers with continuous sludge removal. It is noted that the majority of plants treating waters which yield large amounts of sludge are being designed for mechanical clarifiers and continuous sludge removal. In recent years the "around the end baffle" type of basin is being largely replaced with the straight flow through type. As an additional feature, curtain walls are placed a few feet in front of the inlet to the basin so that the treated water will tend to be distributed equally over the vertical area. This has been found to give higher efficiencies in settling.

A one-million-gallon plant having two practically square basins used a ten-inch perforated pipe about six feet off the bottom along the inlet end of the basins for distributing the treated water. Considerable trouble was experienced in obtaining good settling. It was decided to try in one basin a curtain wall constructed of one-inch by six-inch boards laid horizontally with one quarter inch spacing. The results obtained in this basin were so much better than those in the other that the other was equipped similar to the first one. Another plant of the same capacity was well designed and operated but it was found that the water going to the filters was more turbid than that in the inlet end of the basin. A curtain wall had been placed in the basin about ten feet in front of the inlet and still another about mid-length of the basin. Practically clear water could be seen on the inlet side of the middle wall while on the other side it was noticeably turbid. On removing the middle wall there has been no more trouble.

Sedimentation basins properly designed and with sufficient retention periods are giving efficiencies well over seventy-five per cent in turbidity removal. All the load possible should be removed from the filters, and this is reflected in the length of filter runs obtained at many of the newer plants. Saving in wash water is effected by the longer filter runs.

Filters. Some relatively large plants have used pretreatment and settling only for the production of a clarified water, but in general they have not proved entirely satisfactory and have been replaced by filtration plants.

Filters are usually designed on the basis of a rate of flow of two gallons per square foot per minute. This accepted rate has been increased in some instances and apparently with satisfactory results; however, it is obvious that the water must be low in turbidity as it reaches the filters in order that these increased rates may be obtained without loss of efficiency.

Proper collection of the filtered water and distribution of the wash water is the function of a fundamental part of the filter. For this purpose the lateral system is largely used but in place of using brass strainer heads the laterals are usually perforated. When there is danger of corrosion, the perforations are sometimes fitted with brass ferrules. Less trouble seems to have been had by using perforated laterals. A number of patented filter bottoms are in use, such as the Wheeler, Wagner, Leopold, and the false bottom type. Good results are obtained from any well designed underdrain system.

The gravel placed over and around the underdrains averages about eighteen inches in depth, except that with some of the patented bottoms the depth is reduced to ten or twelve inches with satisfactory results. The number of grades is usually four or five, from 2 or 2½-inch size to ten-mesh material as the top layer.

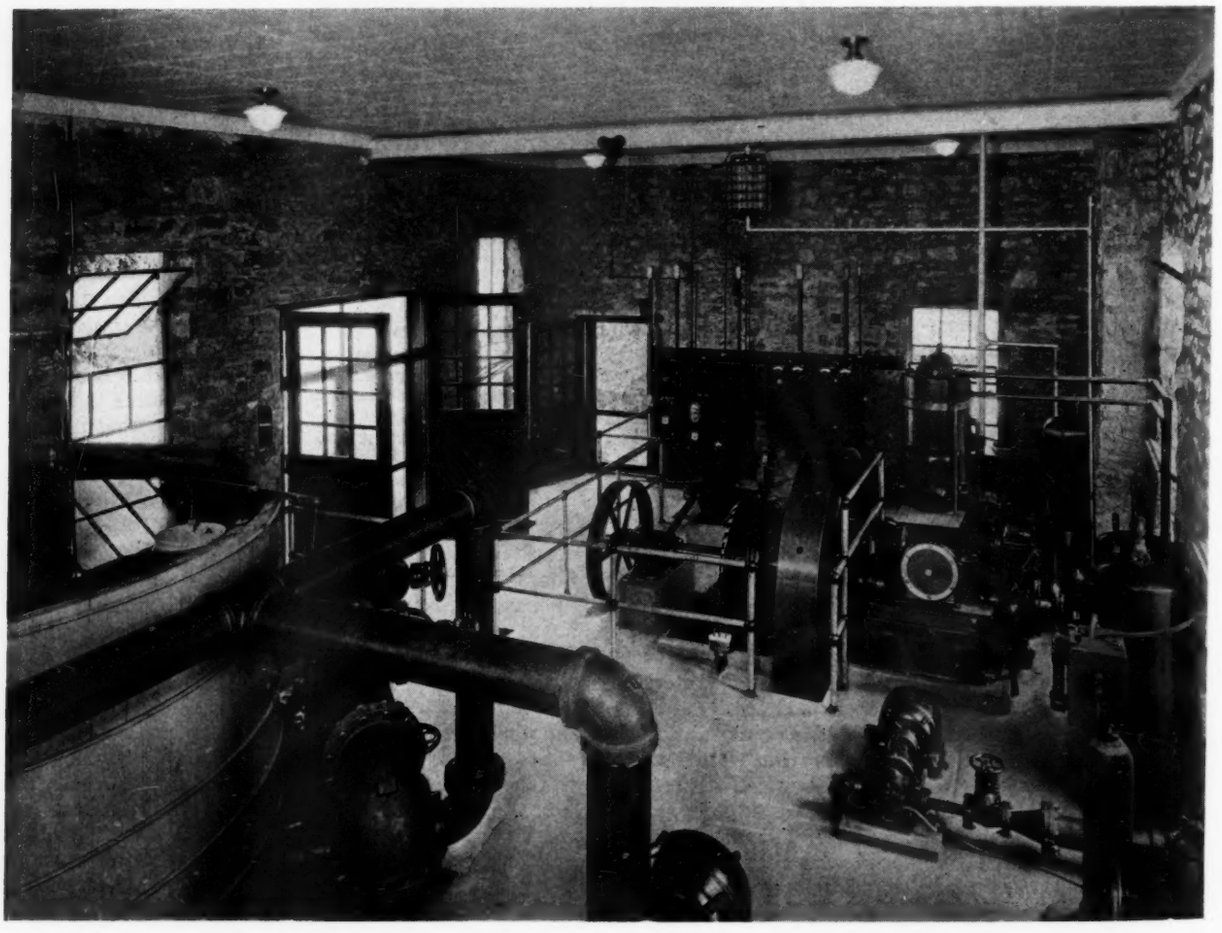
The depth of sand used is between twenty-seven and thirty inches. There seems to be considerable difference of opinion relative to the proper size to use, but the average is probably near an effective size of 0.4mm., and the uniformity coefficient between 1.5 and 1.6.

The freeboard allowed runs between twenty and twenty-four inches, with the spacing of the wash-water troughs at about five feet.

The wash-water rate is pretty generally set at fifteen gallons per square foot per

(*Continued on page 62*)

Building of Lakewood Water Co., Madison, Tenn.



Interior view of building of Lakewood Water Company, showing filtration and pumping equipment.

Socony Cold Patch constructed by State Forces at Glenmont Bridge, Albany County, N. Y.

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for surface treatment

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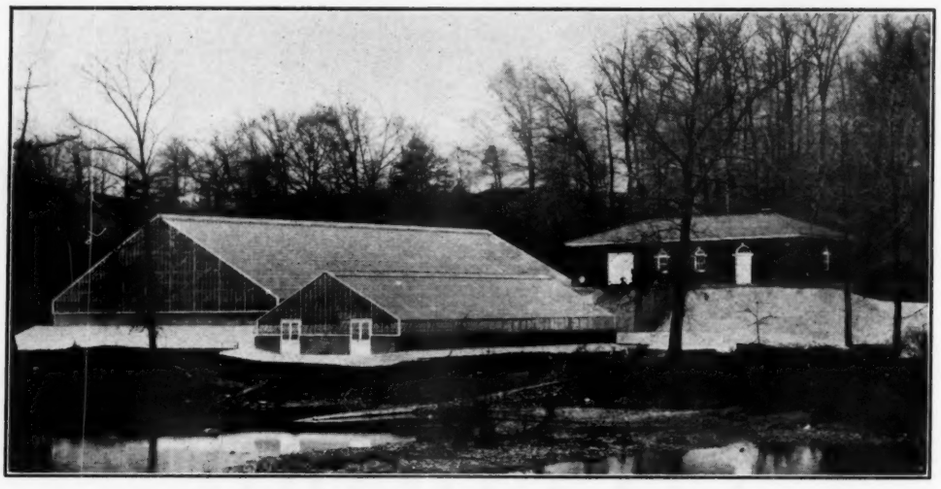
Master Construction Glass-Overs for Sludge Beds



Totowa, N. J. Sludge and Sprinkling Filter Glass-Overs. H. J. Harder, Consulting Engineer; Garwood Ferguson, Borough Engineer. Mr. Ferguson later delegated his position to William Ferguson. Chas. H. Capen, Jr., and P. N. Daniels, Sanitary Engineers.

Controlling Odors From Sludge Beds and Sprinkling Filters With L. & B. Glass-Overs

Glass-overs for the sludge beds for the accelerating of drying, and control of the odors, have gone a step farther. Now the sprinkling filters are also glassed over.

In this Disposal Plant at Totowa, N. J., the smaller glass-over is the usual sludge bed, and the large one, the sprinkling filter. This plant is so located that odors must be under control. The Lord & Burnham Glass-Overs with their ventilating equipment do it.

This plant has a capacity of 400,000 gallons per day, and is so designed that it can be readily increased to 600,000 gallons.

Having been builders of glass structures for over four generations, it was but natural that engineers should come to us for the first sprinkling filter glass-over. Seeing the future in this field, we at once organized a department with a skilled man at its head. The fact that we have built more glass-overs than all other concerns combined would seem to point to the superiority of our construction, and the satisfactoriness of our methods. As a matter of further convincement, let us send you a list of our installations.

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Sludge Bed Glass-Overs

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RECENT LEGAL DECISIONS

By John Simpson

Municipal Waterworks Plant—Reasonable Return

The Wisconsin Supreme Court, Pabst Corporation v. Railroad Commission, 227 N. W. 18, holds that the City of Milwaukee was fairly and reasonably entitled to a return of 8 per cent. on the value of its waterworks plant. The court said: "The water supply business is probably the most essential and beneficent of public utility services. The promotion of sanitation and health, and the very existence of an enormous urban population, are dependent upon the constant and reliable supply of wholesome water in abundance. The margin of profit should not be merely sufficient to provide as fair and reasonable a return as is considered proper for other public utilities, but should at all times be ample to inspire and facilitate the continued development and improvement of the plant, and the efficiency of the service, so that the quality and abundance of the supply will always be well in advance of the actual needs of the community."

The rate of 7 cents per 100 cubic feet, plus the annual service charge of $2 per meter, was held not to permit the city to earn an excessive return on the reasonable valuation of its water plant, or to be unjust, unreasonable, and unjustly discriminatory against users of large quantities of water.

Time of Payment of Waterworks Bonds

A purchaser of advertised municipal waterworks bonds is presumed to have knowledge of the law relative to such bonds. The Oklahoma statute, Comp. St. 1921, §4414, which has been in force since 1893, providing that waterworks bonds shall run for 25 years and be payable at any time after 10 years, at the will of the city or town, must be read into the provisions of bonds issued in 1909, although no mention of this provision for payment is made in the original advertisement of the sale of the bonds, since the law in force when a contract is made becomes a part of such contract as fully as if its provisions had been incorporated in said contract. Board of Commissioners of Harmon County v. R. J. Edwards, Inc., Oklahoma Supreme Court, 282 Pac. 1090.

Engineer's Final Certificate Not Affected by One-Year Guaranty

The rule is well settled in the federal courts that, where the parties to a construction contract provide that the estimates and decisions of an architect or engineer as to questions arising in the execution of the contract shall be final and conclusive, such estimates and decisions have the effect of the award of an arbitrator. In the absence of fraud or such gross mistakes as imply bad faith or failure to exercise an honest judgment, they are conclusive and binding upon the parties.

This rule was applied to the final certificate of completion by the city's engineer under a contract for the construction of a water purification plant, city of Lexington v. Pratt, 31 F (2d) 820. It was held not to be the meaning of the contract that the city board itself should pass upon the quality, acceptability and fitness of the work. And the fact that the matter was left open of repair of minor defects under a one-year guaranty, if after use and upon further test it should be discovered that such defects existed, did not detract from the final character of the certificate.

Any question of delay in completion of the work was for the determination of the engineer, and his certificate provided no allowance therefor.

Venue of Action Against Municipality

The Texas Court of Civil Appeals, City of Dallas v. Hopkins, 16 S. W. (2d) 852, says that while the general rule is that the officers of a municipality should not be required to leave their city and the duties of their offices to answer suits against the municipal corporation filed in other counties, there are exceptions to this rule, where statutory rules provide otherwise, or by reason of the nature of the cause of action, etc.; and an action against a municipal corporation for injuries to the plaintiff's crops from overflows caused by a dam constructed by the municipality and others, based on trespass against real estate under Tex. Rev. St. 1925, art. 1995, § 9, was held properly brought in the county where the trespass occurred, although it was not the county of the municipality's domicile.

Damages for Cutting Off Access to Property

Under art. 1, § 3, par. 1 of the Georgia Constitution and sections 3652, 5506 of the Civil Code 1910, the Georgia Court of Appeals holds, Franklin v. City of Atlanta, 149 S. E. 326, that the owner of an apartment which covered practically an entire lot could maintain an action against the city for damages for cutting off the sidewalk in front of the property, leaving only entrance by the street and diminishing the rental and market value of the property by the destruction of the easement in the street. The Constitution provides: "Private property shall not be taken or damaged, for public purposes, without just and adequate compensation being first paid."

Contract Work Liable to Occupation Tax

The work of a contractor in building a permanent railroad bridge, laying sewers, and constructing a retaining wall as incidental to his principal employment and occupation of digging a new channel for a creek for a railroad company is held by the Ohio Court of Appeals, 32 Ohio Empire Construction Co. v. Cincinnati, 32 Ohio App. 428, 128 N. E. 146, to be activities constituting "occupations" subject to an occupation tax under an ordinance levying a tax on various occupations. Their correlation to and affiliation with the main activity do not, it is held, change their character as occupations or insulate them from the effect of the ordinance.

Indiana Public Works Act Not Applicable to Public Drains Under Drainage Act

The Indiana Appellate Court, Standard Oil Co. of Indiana v. Mason, 168 N. E. 608, holds that the commissioner for the construction of a public drain under the State Drainage Act, who is appointed by the circuit court, is not required, under the Public Works Act, to pay the claim of one furnishing gasoline, oils and greases to the contractor, since the commissioner of construction appointed by the court in which the drainage proceeding is pending is not mentioned in the latter statute, nor does that act purport to cover a public work under the supervision and direction of the circuit court.

Procedure in Sale of Municipal Power Plant

An incorporated town is a creature of statute, having only such powers, and the right to exercise these powers only in such manner, as are authorized by statute. Therefore, the Colorado Supreme Court holds, Inland Utilites Co. v. Schell, 285 Pac. 771, an ordinance which attempted to ratify the sale of an electric power plant and the grant of a franchise to operate it, and an ordinance attempting to authorize a submission to the voters of the question of whether or not its electric power plant be sold and a franchise be granted, were held to be null and void where, in adopting the ordinances, the procedure provided by the statute therefor was not followed.

Land Owner's Contract to Construct Water Mains

The Ohio Court of Appeals holds, Ford Realty & Construction Co. v. City of Cleveland, 30 Ohio App. 1, that a company which agreed in writing with a village to install water mains and make all connections thereto in an allotment owned by it without expense to the village, with right to the village to use the mains, gave no right of reimbursement to the company when the village was annexed to an adjacent city, there being no contract between the village and the city whereby the latter agreed to pay anything.

Location of Road Near Limits of Village

The Illinois Supreme Court holds, Department of Public Works and Buildings v. Epperson, 333 Ill. 313, that the determination of the Department to locate a hard-surfaced road under the $100,000,000 Bond Issue Act through a section of a village near its limits rather than through the centre of the village is a minor change which is authorized by the statute, where there is no question that the new location will accommodate travel over the road and connect "intervening communities," as required by the act, and there is evidence that it will avoid right-angle turns and other dangers; and it is not incumbent on the Department to construct the road through the centre of the village even though such construction is desired by the inhabitants.

Control of Construction of State Highways in Minnesota

The Minnesota Supreme Court, State v. Babcock, 175 Minn. 583, holds that Minn. Laws 1925, c. 426, creating the commission of administration and finance, modifies and amends the prior highway act to the extent of placing the making of contracts for constructing state highways under the control of that commission; and where a contract for such work made by the highway department is disapproved by the commission, it does not go into effect and delivery thereof cannot be compelled by mandamus.

Minnesota Statutory Bond of Engineer in Ditch Proceeding

The Minnesota Supreme Court holds, County of Yellow Medicine v. Johnston, 222 N. W. 289, that the statutory bond given by an engineer in a ditch proceeding covers not only negligence in the survey but also negligence in supervising construction and the issuance of certificates through which contractors may obtain payments as the work progresses. In such a bond conditions added to those prescribed by the statute are held surplusage.

Zoning Ordinance—Height of Building

Where an owner proposed to erect upon his lot in the City of Yonkers a building with the entrance wall facing the rear of the lot and the opposite or rear wall facing the street 13 feet higher than the zoning ordinance permits the "front" wall of a building in that district to be, although the wall of the entrance side, facing the rear of the lot, was within the permitted height, the New York Appellate Division held, Rollins v. Armstrong, 233 N. Y. Supp. 359, that the height of the building must be measured from the street side of the building. This was affirmed by the Court of Appeals, 251 N. Y. 349, 167 N. E. 466 holding that "the front wall of the building within the meaning of the zoning ordinance of the city of Yonkers is the one fronting on the street, and not the one designated by the builder as the front."

Municipalities in Texas Cannot Contract Away Right to Build and Operate Light and Water Systems

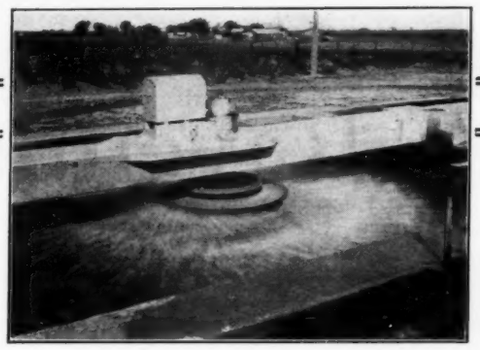
Under the laws of Texas cities and towns are given authority to build and operate light and water systems. Complete Texas St. 1928, article 1111. This is a right that cannot be contracted away. Article 1, § 17, Texas Constitution; City of Brenham v. Brenham Water Co., 67 Tex. 542. Therefore, it is held, Fairbanks, Morse & Co. v. Texas Power & Light Co., Circuit Court of Appeals, Fifth Circuit, 32 F (2d) 693, the city of Commerce, Texas, had the right to erect its own electric light plant at any time the proper officers should see fit to do so, regardless of an existing contract with a company to supply electric power and energy to the city and private consumers in the city. The suit was by such company against another utility to restrain the latter from interfering with the plaintiff in the performance of its contracts with the city and its inhabitants. The appeal was from a decree granting a preliminary injunction. The court concluded that, as far as the record disclosed, the defendant was acting legally and within its rights in entering into a contract with the city for the erection of an electric power plant and distribution system and then soliciting private parties to become customers of that plant when their contracts with the plaintiff were lawfully terminated. The court said that it was not concerned with the question of damages in regard to the city's action, and that it was immaterial whether the defendant approached the city with the suggestion of building a plant or whether the inquiry came initially from the city.

Change of Plans Not Prejudical to Bidders

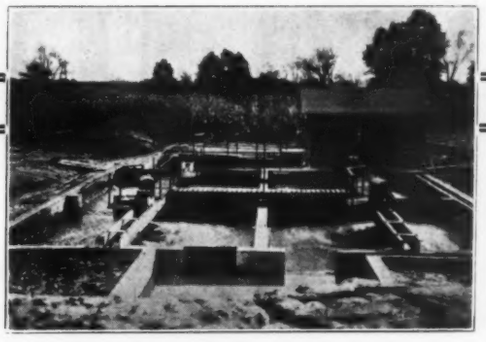
Where all the bidders for the heating and ventilating system for a city hall bid on the same plans, an unsuccessful bidder and taxpayers did not suffer any special injury by a change of the plans and specifications by a new city architect and could not claim irregularity in the adoption of the changed plans and specifications.—Conklin v. Mayor, etc., of City of Linden, New Jersey Supreme Court, 146 Atl. 31.

Irregularity in Procedure Held Not to Void Executed Street Improvement Contract

Where work is performed upon a street of a city and at its instance, and the city has accepted and is enjoying a valuable benefit of the work, the Kansas Supreme Court holds, Du Bois v. City of Galena, 276 Pac. 802, that the city cannot escape liability for the reasonable value of the work because of a mere irregularity in contracting for its performance. The contention here was that the petition of the plaintiff, a contractor, to haul dirt to make a fill for a sidewalk, was demurrable for failure to show that there had been an estimate of the improvement by the city engineer, and that the contract had been let for a price within such estimate in compliance with the statute.



One of five Simplex aerators in service at the Frederick, Oklahoma, Sewage Purification Plant. Designed by the Benham Engineering Company, Oklahoma City, Oklahoma.



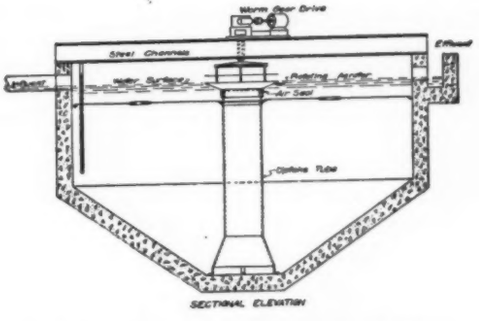
Sewage Purification Plant at Christopher, Illinois, four Simplex aerator units. Designed by McCarty & Elder Engineering Company, Marion, Illinois.

Proving the Effectiveness of SIMPLEX Mechanical Surface Aerators

INSTALLATIONS such as those pictured above prove every contention made for the effectiveness and economy of SIMPLEX Surface Aerators in sewage purification plants.

Both Domestic and Industrial waste treating plants are operating successfully on the principle of sewage treatment through activated sludge produced by mechanical surface aerators.

May we explain more fully how the "Simplex" Aerator Unit gives greater flexibility in plant construction and operation with the least power consumption and maintenance costs?



Single Unit "SIMPLEX" Aerator in Tank

The revolving aerator receives its sewage through the intake tube from bottom of tank and is equipped with vanes that throw an upper and lower film of sewage over the surface of the tank. Oxygen absorbed by the films, the surface agitation and complete circulation of sewage will give any degree of nitrification desired, determined by the detention period in the tank.

Sole Manufacturers in the United States and Canada

SIMPLEX *SURFACE* AERATOR

SIMPLEX EJECTOR AND AERATOR CORPORATION

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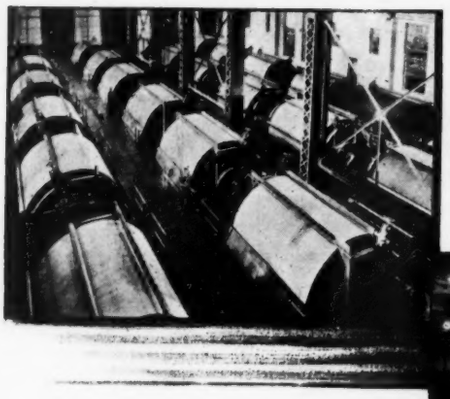
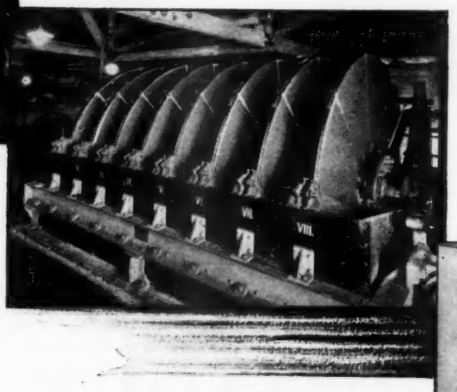
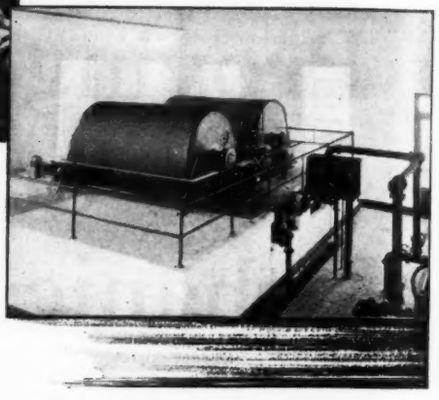


Here's Revenue

to Offset Sewage Treatment Costs





Regarding Houston, Texas--the Oliver United filter was not damaged in the fire. It will soon be in service again together with three more large units recently ordered.

Milwaukee, Wisconsin,
is selling right along its daily production of 100 tons of "Milorganite," the activated sludge discharged from the Oliver United Filters.

Pasadena, California,
is selling its daily production of 6 tons of filtered sludge.

Houston, Texas,
before its fire operated one Oliver United Sludge Filter. Three more units are going in, after which the plant is all set to turn out about 15 tons of sludge a day and sell it.

Charlotte, North Carolina,
is giving most of its filtered sludge away to the farmers—"haul it yourself." This eliminates all disposal charges.

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Economics of Highway Design

(Continued from page 49)

A few states reach full widening at the point of curvature. The spiral transition curve is used by the majority of states for the easement at the end of the widening, although some states prefer the straight line transition. With the general use of wide curves, the widening of the pavement is becoming less important, and where 1000 feet radius curves are built, the widening of the pavement would seem to be an unnecessary expense.

Slight changes in direction should preferably be made on summits instead of in the valleys, but sharp changes in direction (over 3°) should preferably be placed so that they will be visible for at least 500 feet ahead. Sharp horizontal curvature should not be combined with vertical curvature. Where any convex vertical curve is combined with a horizontal curve the horizontal curve should extend beyond the ends of the vertical curve. Abrupt curves should never be used at the ends of long tangents, as they constitute far greater sources of danger to traffic than would the same degree of curvature used in rugged country where curves are necessarily frequent and drivers of vehicles are expecting them.

Grade

The grades on main line highways are usually not over 5% in gently rolling country and 7% in rough country, but rather than resort to sharp curvature, grades as steep as 9% are sometimes used. The mountain standards used by the European engineers and followed until recently by American engineers, involving low gradients but numerous "switch-backs" or "hairpin turns" of short radii, were designed for horse-drawn vehicles and are neither safe nor satisfactory for modern motor traffic.

Considerable research has been done in an attempt to determine the most economical grade, but due to the wide difference in engine power of vehicles, the difference in driving habits of vehicle operators, and the difference in vehicle loadings, it has been difficult to develop a satisfactory formula for economical grade. Professor Agg has developed from his studies that gently rolling grades are not uneconomical in transportation costs if the length and maximum per cent of grade are judiciously selected; and as a further support for the rolling grade line, our soil studies have shown that the top or weathered soil usually makes a more stable subgrade for the pavement than the deep or unweathered soils. Professor Agg's general principle is that the most economical grade is one that will permit the vehicle to ascend in high gear at the most efficient engine speed and to descend without the use of brakes and without attaining too great a speed. With the engine power, gear ratios, wind resistance, rolling resistances, and braking power of automobiles constantly changing, the highway engineer will have to qualify also as a prophet if he is to successfully plan highway grades today for the motor cars of 10 or 15 years hence.

In mountain road design, where curves of relatively short radii occur on grades of over 5 to 6 per cent, it is customary to compensate the grade in order that ascending vehicles will not lose momentum through deceleration. The amount of such compensation depends somewhat on local conditions, but generally is not less than one-half per cent for each 50-foot reduction in radius below 500 feet.

The length of vertical curves has increased with the increased speed of vehicles and the necessity for greater sight distance. On main line highways the vertical curves at the summit of hills should be sufficiently long to give at least a sight distance of 500 feet, and the center line marker should be used to further safeguard traffic at such points. For 500-foot sight distance, the length of the vertical curves in stations should be five-eighths of the algebraic difference in grades.

WIDTH AND CROSS SECTION

The 3-rod and 4-rod width of right-of-way so common in the days of horse-drawn vehicles has proven inadequate for modern highway requirements, and there is now a noticeable trend toward the acquirement of 100 or 200-foot strips. This extra width provides room for future pavement widening, for parking of vehicles, for bridle paths, foot paths, public utility lines and shrubbery. It also permits more adequate control of objectionable sign boards, lunch stands and filling stations which so often obstruct traffic and disfigure the highway.

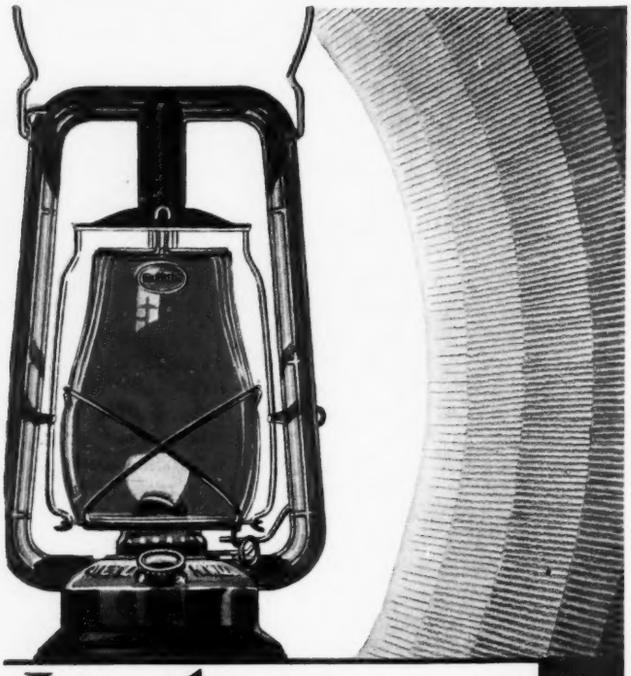
Walk-Ways—There is considerable discussion just now relative to walk-ways along rural highways and several states expect to start in soon on a program of walk-way construction, especially in the vicinity of rural schools where so many children are in jeopardy.

Side Slopes—The side slopes in both cut and fill were formerly made as steep as the material would stand, but such slopes wash so badly that vegetation is very slow to develop on them, and best present practice calls for flatter slopes which permit a rapid growth of sod and shrubs, which not only serve as protection against excessive wash, but add greatly to the appearance of the road.

Crown—With increased care in developing true pavement surfaces there has come a flattening out of the crown of the pavement, and at the present time the transverse slope is rarely more than ⅛ inch or 1/10 inch per foot for hard pavements, and ¼ inch per foot for lower-type surfacings. Most state specifications require a trueness of finish for hard pavements within ¼ inch under a 10-foot straight edge, and some states permit even less tolerance.

Shoulders—The motor vehicle today is less subject to breakdown than formerly, but with the increase in volume and speed of traffic, a car parked on the pavement proper constitutes a source of danger and congestion, and for this reason the modern highway should have shoulders 6 feet to 10 feet wide for emergency parking. In some states the shoulders are solid and kept neatly trimmed, in other states gravel and crushed stone are used, and in still other states bituminous treatments of various kinds are used to

Benching out a roadway along a canyon wall in Montana



In the Public Eye

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eliminate dust and protect the shoulder from wear and erosion. Shoulder slopes are now much flatter than formerly and ditches much shallower.

Pavement Width—For safe passing at usual driving speeds, the traffic lanes should be at least ten feet wide, but due to limited funds many states still construct 18-foot pavements for two lanes of traffic. Traffic studies show that the average clearance between cars passing in opposite directions on an 18-foot pavement is approximately 1 foot, and on a 20 foot pavement approximately 2 feet. On both 18 and 20-foot pavements drivers evidently prefer to sacrifice clearance rather than drive close to the edge of the pavement. On pavements over 20 feet wide there is a marked tendency to drive further away from the edge of the pavement, only about 46% of the drivers utilizing the section within 6 feet of the edge.

When the volume of traffic exceeds the capacity of a two-lane pavement, a four-lane pavement should preferably be built. The three-lane pavement has some advantages, but it is rarely economical because it usually does not accommodate much more traffic than a two-lane pavement unless, through adequate traffic control, two lanes in one direction are operated during peak periods when traffic is predominantly in one direction. Traffic studies indicate that the capacity of a four-lane highway may be as much as three or four times that of a two-lane highway on account of the separation of fast and slow vehicles.

In addition to the traffic lanes, extra width should be provided in villages and cities for parking purposes. Where parallel parking is permitted, eight feet of additional pavement on each side should be provided, and for diagonal or right angle parking, fifteen feet extra are needed, making the total pavement width in built-up areas 36 feet or 50 feet for normal two-lane pavements.

(*To be concluded*)

Present-day Water Treatment Processes

(*Continued from page 54*)

minute and the troughs designed for this rate.

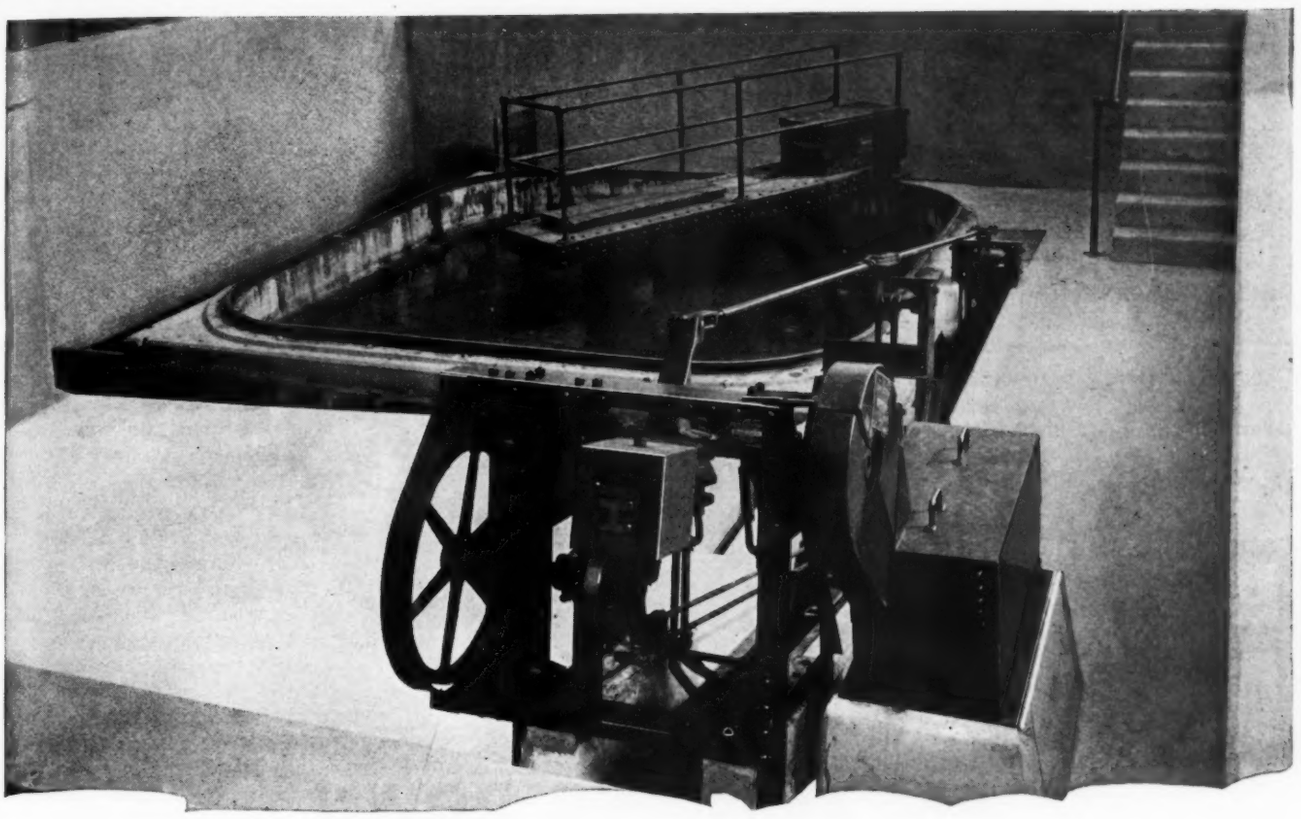
Some excellent experimental work has been carried on for the past year or so at the Detroit, Mich., and Cleveland, O., filtration plants using higher wash-water rates than the accepted standard. Troubles with the filter sands at both of these plants have been largely eliminated by the higher rates of wash.

Another development has been the use of caustic for cleaning filter sands in place. The method used at the Detroit plant has proved of considerable value in a number of plants with which the writer has been in contact.

Chlorination. Filtration of a contaminated water is always followed or preceded by disinfection, usually with chlorine. Standard practice has been to add the disinfecting agent following filtration. There is now some tendency toward prechlorination followed by post-chlorination. This is particularly helpful when a highly contaminated water is being treated.

There are certain waters which, when treated with chlorine, give better results with the coagulant, effecting noticeable economies in the amounts of coagulants required as well as increasing the filter runs and thereby decreasing the quantity of wash-water required. Some waters have a tendency to coat the filter

(*Continued on page 82*)



This DORR DETRITOR solved the grit removal problem in the sewage treatment plant at High Point, N. C.

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At the East Side separate sludge digestion-trickling filter plant at High Point, considerable interference with proper plant operation was caused by the grit in the sewage. The remedy was found by installing the Dorr Detritor shown above. The Detritor now removes the grit from the flow continuously and prevents it from interfering with the subsequent steps in the treatment process.

Mr. W. C. Olsen, Raleigh, N. C., designed this plant and also the West Side activated sludge plant, where another Dorr Detritor is now being installed.

Dorr Detritors have been selected recently for a number of important sewage projects in the United States, Canada and Europe. The trend toward mechanical equipment for all sewage treatment steps indicates that plain grit chambers will soon be as out-of-date as plain bar screens or old-fashioned settling tanks.

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The *classified* INDUSTRIAL LITERATURE section is your guide to the latest catalogs—see page 101

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Water Supply Problems in Holland

(*Continued from page 20*)

on borings, 30,000 boring samples and 9,000 water analyses are now available. The results of its studies are published at irregular intervals.

To encourage the construction of waterworks, especially in rural districts, the government not only contributes towards the cost of plans, but often takes over the financial risks of new enterprises, thus practically safeguarding the community-shareholders against any financial difficulties.

All questions regarding the hygiene of "water, soil and air" were, by the Public Health Act of 1901, put under the control of the "Inspectors of Public Health"; while a central laboratory, established in Utrecht, yearly examines the water of all waterworks in Holland chemically and bacteriologically.

The Geo-Hydrological Conditions

The greater part of the country is of a lowland character, only a few spots rising more than 300 ft. above Ordnance Datum (N.A.P. = Amsterdam level). The level of 1 metre (3 ft. 4 in.) + N.A.P. has been indicated on the map, fig. 1; west and north of this contour line the land would be submerged at high tide and by every flood in the rivers, but for the dunes and dikes.

These dunes were formed by the wind on the sandbanks which had been deposited in a shallow part of the sea, thus creating a so-called "haff." The original salt water in this haff was gradually replaced by fresh; sand and clay filled the lake, and a moorland vegetation grew up, which later originated moors and fens. As the line of defence was interrupted at several places by the outlets of continental rivers, and was broken by heavy gales, inland seas (like the Zuider Zee), river deltas and islands were formed, while a general settling of the land (or, as some put it, a rise of the sea level) contributed towards the necessity of constructing sea defences.

In the pleistocene and holocene periods, during the inundations, the different layers of the soil were impregnated with salt or brackish water. But in the dunes, where the rain readily could percolate, this salt water gradually was replaced by fresh, thus forming the typically lens-shaped fresh-water accumulations, schematically shown in fig. 3. This phenomenon, resulting from the different specific weights of salt and fresh water, was first observed by the Dutch military engineer Badon Ghyben in 1889, and twelve years later was confirmed by the investigations carried out by Herzberg on the island of Norderney (Germany).

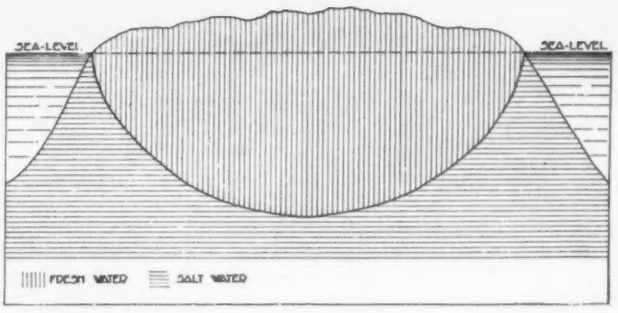

Fig. 3—Equilibrium of ground water in a sandy island (according to Badon Ghyben)

These fresh water supplies, being limited, have to be handled in the most economical way, and special attention has to be devoted to preventing a rising of the salt water level, which, in several parts, is to be found at some 350 ft. below N.A.P.

The Castricum pumping station of the North Holland water service uses the deep layers exclusively, impermeable strata below the fresh water in this locality protecting it against a rise of the brackish zone. The Leiden and Amsterdam works and the other dune waterworks only partly use the deeper layers, and mainly take their water higher. This water is captured either by means of shallow wells (Haarlem), by open channels (Amsterdam), or by covered drains (the Hague).

Thanks to the investigation of Mr. Pennink, late director of the Amsterdam waterworks, and others, a clear insight has been obtained into the rather complicated hydrological conditions of this part of the country, in which at present over two million inhabitants find their source of supply.

The results of investigations carried out by the Government Bureau of Water Supply in the dunes near Schoorl, are shown in fig. 4. (It should be noted, that in this drawing the horizontal scale is one tenth of the vertical scale.) As may be gathered from this figure, part of the dune water flows off land-

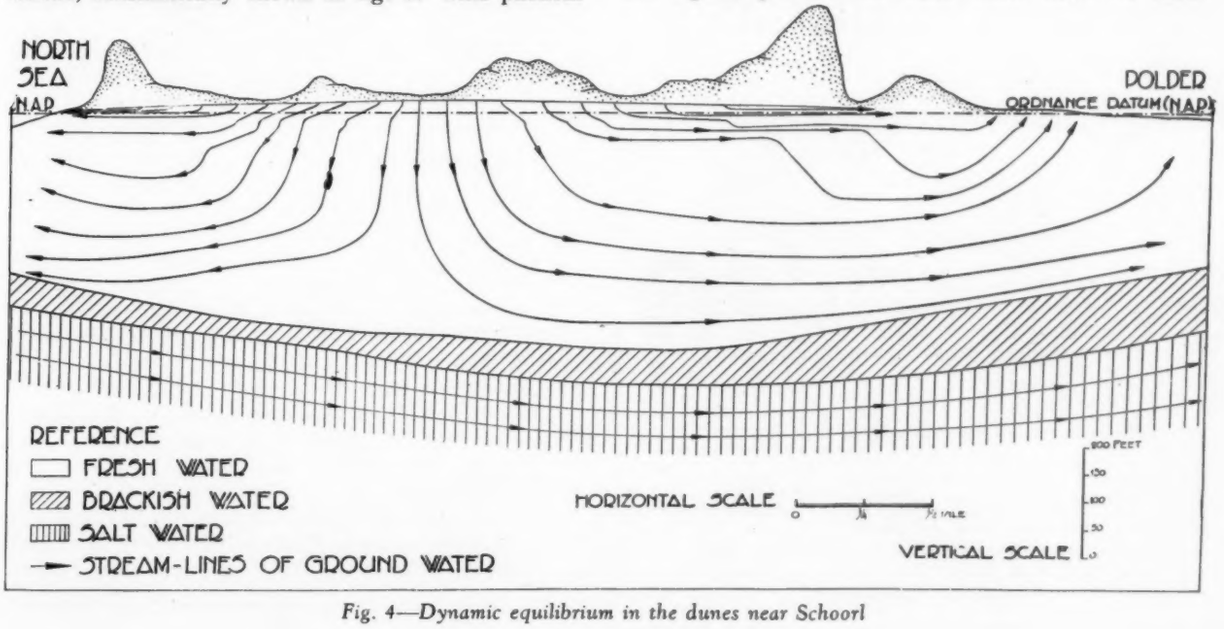

Fig. 4—Dynamic equilibrium in the dunes near Schoorl

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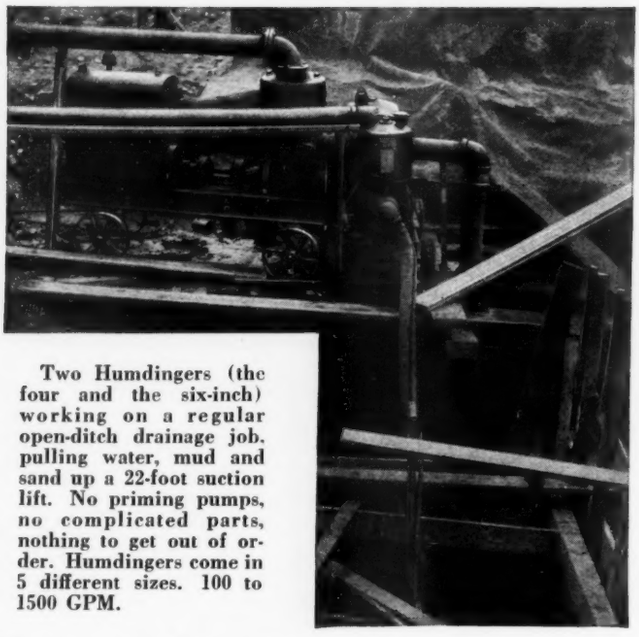

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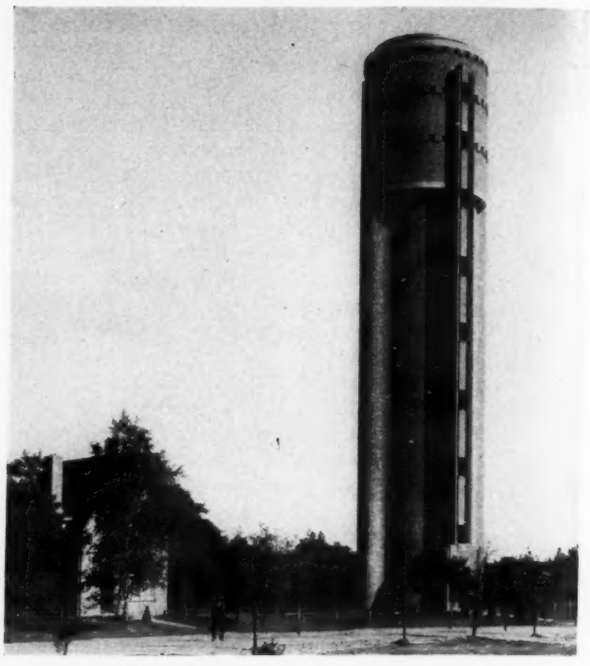


Water Tower at Bilthoven; Architect, H. F. Mertens

ward, towards the polders.* By the layers of peat it encounters it is often rendered unfit for consumption, however, and the inhabitants in these districts have to depend on rainwater, except where a piped supply has been established.

Conditions are a little more favorable in the eastern part of the Netherlands, where are found pleistocene sands and gravels, which, if protected by layers of clay, yield water of excellent quality. Generally these ground waters require deferrization and demanganization; in some cases, however, they are distributed without any previous treatment (Utrecht, Arnhem). Several waterworks use the deeper pleistopliocene strata, taking the water at a depth of 250-300 ft. (Nijmegen, Assen); while in North-Brabant some works draw from wells sunk into the marine upper and middle pliocene and miocene formations, at a depth of 350 ft. and more; which layers yield a water of greater hardness than that from higher-lying strata, which is rendered as soft as possible but has no accompanying aggressive properties.

In the southern part of Limburg, water is often drawn from the chalk formations (Heerlen), while towns along the river Meuse (Maastricht, Sittard, Roermond, Venlo) utilize the pleistocene sand and gravel terraces, which generally carry water abundantly.

Some Problems of Today and Tomorrow

Dune supplies being of limited capacity, a special problem arose when it was proposed to construct the new sea-lock at Ijmuiden (the entrance to the harbour of Amsterdam) "in the dry." In the immediate vicinity of this lock large quantities of dune water are being drawn for industrial and domestic purposes, and fears were expressed that this would be depleted by the pumping necessary for unwatering the excavation, which was more than 50 feet deep; and that such unwatering would so reduce the downward pressure at that point as to cause the salt water to rise into the fresh. At the site of the excavation layers of clay were found at 60 ft., 130 ft. and 330 ft. below O.D., and it was suggested to reduce the

*A low tract of land reclaimed from the sea or other water by dikes.

ground-water pressure under the 60 ft. stratum by means of wells, while isolating the excavation from the surrounding water-bearing sand by means of steel sheetpiling, driven down into the 130 ft. clay layer. After preliminary tests on a small scale, which were carried out in collaboration between the direction of the works and the Government Bureau of Water Supply, this plan was followed and proved to be very successful; while the pumped water was not wasted, but was delivered to the North Holland Water Service and distributed after having undergone the necessary treatment.

With a population of some 750,000 and rapidly increasing, Amsterdam, which also supplies the surrounding communities with water, has for several years been faced with the necessity of finding other sources of supply; the existing sources (the dunes at Leiduin, a ground water station near Hilversum and a canal water station at Weesperkarspel) having reached their maximum capacity. Proposals were made to irrigate the dunes by river water, elaborate investigations were made of the possibility of new ground water supplies from the Gelderland hills, and a river-water supply from the Rhine near Rhenen was contemplated. Finally it was decided to utilize a lake at Loenerveen, which to a certain extent will act as a storage reservoir, the water in the lake being supplemented by water pumped from the Bethune polder and from the river Rhine.

The Hague, the seat of the Netherlands government, with a population of 450,000 (which also is growing rapidly), uses the dunes exclusively for its water supply, but will within the near future have to fall back on other sources, probably one of the rivers.

River water supplies in Holland, however, have had to cope with increasing difficulties of late years, especially taste troubles. Most of the river water comes from Germany, through the Rhine, and tastes noticed at Rotterdam (at present supplying water to a total population of some 740,000) were supposed to originate in the mines and blast furnaces of the Ruhr district; although some ascribe them partly to actinomyces and other organisms. Ozone and other treatments proved ineffective, but filtration through "Norit" activated charcoal removed the odor, and charcoal filters are now being installed permanently.

Future problems of a different kind arise in connection with the reclamation of the Zuider Zee, a big national enterprise costing some $200,000,000 which is now in full swing. It will add some 550,000 acres of fertile land to the country. One of the four polders (the N. W. one) will be ready for occupation by 1931.

The soil of these new polders having for centuries been saturated with salt water, there is not much hope of finding fresh ground water for the population which may be expected to settle there. Schemes are already being worked out providing for a water supply from the neighboring provinces. It is further hoped that the Yssel lake, which will be left between the four polders, may, after some lapse of time, contain fresh water brought into it by the river Yssel and other small streams.

Architecture of Water Towers

In a flat country like Holland, water towers, especially those for district supplies, form a conspicuous element in the landscape. Rather than build mere elevated steel tanks, the general tendency is to give these towers a pleasing aspect in harmony with their surroundings. A great number of these structures have been erected within the last few years, of which four, by different architects, are reproduced here. The tanks proper are generally constructed of reinforced concrete, which material also is utilized for the supporting columns; while the national product—bricks—often finds application for the exterior. The photographs may convey some idea of modern Dutch architecture in the service of a public utility. As will be noted, no attempt has been made to conceal the functional parts of the structures.

Sixth International Road Congress

More than fifty nations have accepted the invitation of the United States Government to participate in the Sixth International Road Congress to be held in Washington, October 6 to 11, and officials in charge are entering the final stage of their preparations to receive the large number of delegates expected.

The congress will be held under the auspices of the Permanent International Association of Road Congresses, with headquarters in Paris, and under the immediate direction of the American Organizing Commission, Roy D. Chapin, president, with offices in Washington.

Seventy-six separate reports, printed in French, German, Spanish, and English, the four official languages of the congress, will form the basis for discussion at the sessions in October. The reports represent the studied opinions of 170 of the principal world authorities on the moot questions of highway construction, design, material, maintenance, administration, finance, and traffic.

More than a year ago the several topics to be studied at the congress were decided upon and the chief exponents of the various questions assigned to write upon them. The result has been a series of articles and papers that represent most that is known today of the twin sciences of highway construction and automotive transportation.

For months a corps of translators has been engaged in the task of preparing the reports to the congress in four different languages. The English and Spanish translations have been made in Washington under the supervision of engineers and editors of the United States Bureau of Public Roads, while the French and German versions have been made in Paris under the immediate direction of M. LeGavrian, secretary-general of the association.

With the task of translation and printing completed, the reports are being mailed to the far corners of the earth, so that delegates coming to Washington this autumn may fortify themselves to support or to attack the theories and conclusions set forth in the reports. Each member of the association will receive a collection of the reports in that one of the four languages with which he is most familiar. Membership in the association is essential to participation in the congress.

The net result of this distribution will be a world study of highway problems preparatory to the serious discussions of the congress itself. Following the congress, the proceedings, containing the debates, will likewise be published in the four languages.

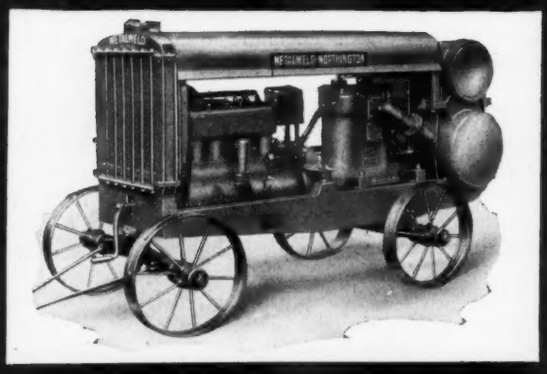
Snow Removal Practice in Three Cities

(Continued from page 30)

railing or dumping over the railing; in the case of new bridges a special snow-hole opening in the form of a casting with a removable top has been installed in the roadway of the bridge.

We have been unable to keep exact unit costs on this work which can be considered reliable. The cost per season to the city, averaged over a period of five years, has been approximately five thousand dollars, which covers the cost of snow removal only where

M-W AIR KING



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necessary, which includes about five miles of streets; plowing methods alone being used on the remainder (about fifty miles).

With the small equipment at our disposal we have been able to keep the main streets of our city open during the winter weather with very little inconvenience to the traveling public. Our local press has often commended the results we have attained in keeping the streets and highways open after a snow storm.

Corrosion in Underground Iron Structure

(Continued from page 32)

(2) The moisture content of the soil.
(3) The presence of dissolved gases, such as oxygen, carbon dioxide and hydrogen sulphide, which affect both the rate of corrosion and the nature of the end products.
(4) The mechanical and chemical properties of the soil surrounding the structure.
(5) The depth of buried metal. This is mainly a function of the moisture in the soil. Corrosion increases with depth because the concentration of moisture increases with depth
(6) Temperature of the soil, because of its effect upon current flow.
(7) The limitation of flow due to polarization.
(8) The formation of high-resistance films on the surface of the metal.
(9) Pitting of the surface of the metal, which tends to either increase or decrease the rate of decomposition.
(10) Changes in polarity of underground pipe. The polarity may change in periods of from a few seconds to a couple of hours, due to shifting of the load.
(11) A decrease in corrosion occurs with an increase in the frequency of reversal of current. There is a limiting frequency above which practically no corrosion occurs. (15 to 60 cycles per second.

Reduction of Corrosion.—The rate and extent of corrosion can be controlled to some extent by paying close attention to one or all of the following things.

First.—Limiting the voltage drop in negative return lines.

Second.—By the use of protective coatings on all underground metal structures. These coatings may be of paint, fibre or fabric, but the coating must be continuous without flaw or break to be effective.

Third.—By the selection and use of materials that are more resistant to electrolytic action.

Acknowledgment. — Assorted papers from the Bureau of Standards and the Journal of the American Water Works Association.

Public Utility Relations

(Continued from page 36)

discontinuance of all or any part of the service, and the payment of 50c fee therefor." The resumption of the service is required in the same manner.

Thus the occasional customer who desires something at the expense of the other customers is eliminated; credit adjustments to the customer are made a matter or permanent record instead of memory; and the average customer is better satisfied. These methods have reduced the amount of water rebates about 90%.

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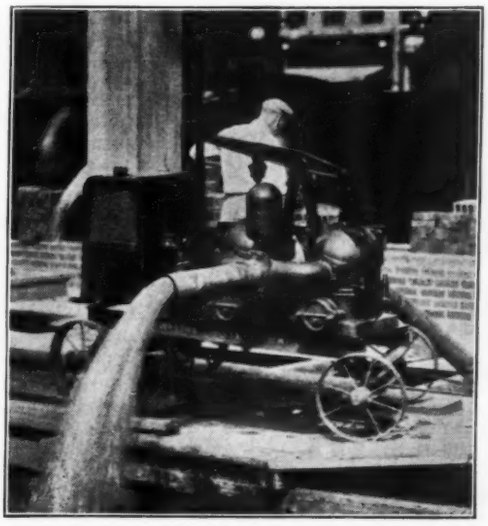
For this Novo 62-C Pumping Outfit ran continuously night and day for 47 days—1,128 hours.

And the job was far from easy. The pump was used to de-water the footings for the Consumers Power Company's new office building, under construction at the edge of a canal.



This is the Novo 62-C Pumping Outfit that pumped close to capacity for 1,128 hours without a stop, setting a new endurance record.

The footings extended eleven feet below the canal bottom, making an unusually large volume of water, which forced the pump to run at capacity most of the time. The water was lifted a total of 21 feet.

Actual performance records such as the above are the best proof of what a diaphragm pump can do for you. The Novo Pumping Handbook gives you such information on all kinds of pumping jobs. Write for your copy today.

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Efficient Operation of Concrete Paving in Pennsylvania

(Continued from page 25)

a representative to the job to ascertain what the contractor was doing with the exceptionally large amount of cement being shipped to the job. They thought he was selling it.

These two contractors now realize that our suggestions have been constructive and for their benefit. The only additional costs per day are for materials and their transportation, which are job charges and cost the same whether progress is fast or slow. In fact, with slow progress the transportation costs actually increase. The amount of labor is practically the same for the good as for the poor production. Additional savings in equipment rentals and overhead are apparent. The final clean-up of jobs will be performed in good weather instead of poor, with greater profit to the contractor. The hauling contractor makes a better profit and we may expect him to gravitate to the more efficient projects.

Many other contractors are steadily reducing lost time and increasing production to a remarkable extent. We feel that our 1930 record will be much better than previously. On a job visited recently, the mixer operator was very proud of the fact that he was averaging 35 batches per hour and promptly told our representative from the Central Office what he was accomplishing. He stated further that it was his ambition to be the most efficient mixer operator in the state and wanted to know whether anyone was beating his record. This is the spirit that wins. We would suggest to the paving mixer manufacturers that they secure demonstrators who can go on a job and produce in this manner, which will go farther in promoting sale of new pavers than promises of salesmen as to what production can be made. The manufacturers should give prizes for efficient mixer operation.

It is our intention in Pennsylvania to prepare a weekly report showing comparative records of all paving contracts for the particular week. This report will show the amount of available time, time lost, actual time and percentage of time lost. It will also show the number of batches per hour when actually operating and the percentage of efficiency based on a maximum of 40 batches per hour. No mention will be made of lineal feet or square yards of pavement laid on account of varying widths and depths of pavement, as well as varying weather conditions on individual jobs. Ratings, from Division and State standpoints, will be shown for each contract. Copies of the report will be furnished all paving contractors, contractors' organizations, bonding companies and Department representatives. It is hoped that it will establish a rivalry which will result in increased production of highest-quality pavement, which means a very distinct benefit to the entire industry.

It is recommended that not only individual contractors, but constructors' associations also, give most careful consideration to these time and efficiency studies, and that the associations operate in the same manner as other trade associations by making time-saving and other economic studies which will result in more lucrative operations. Other trade associations have found it to their advantage to present all available data to their individual members with a view of increasing prosperity of the industry in general. There has been a tendency on the part of contractors to ridicule time studies and other records which have

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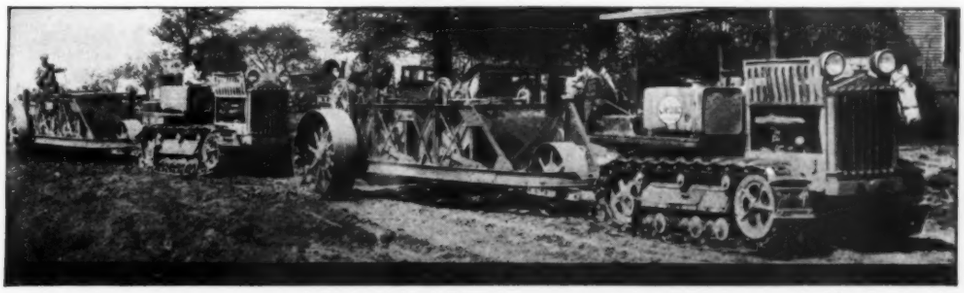

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been prepared and presented by engineers. Records of this kind will not receive the attention they deserve until they are prepared and presented by constructors' associations. The methods which have proved successful on one job will prove successful on another, other factors of the management being equal.

Competition is becoming keener. Many contractors, especially those with the "Andy" attitude, which is "dumb but refusing to admit it," will fail. Some of these are, unfortunately, our older and more experienced contractors. Many have failed in other industries, but in those industries the remaining firms profited by these failures and increased the efficiency of their plant and organizations. This must happen in the highway construction industry before it can take its rightful place as one of the stable industries of the country.

Building the Hydraulic Fill Saluda Dam

(Continued from page 28)

the shape of the core, and samples of the core were tested periodically to determine the sizes and character of the particles. Sluicing was stopped when the elevation of the core reached 340, and selected materials dumped in the pool until they reached elevation 350, when the water was pumped out and the remainder of the dam built by consolidating selected materials.

The borrow pits were located on both sides of the valley and both above and below the dam. And so much material of excellent quality was so widely available that the points of excavation were moved up hill as the dam rose, so as to maintain the tracks from the pits with slight down grades toward the dam. The material found included decomposed granite gneiss, decomposed schist, brown and red clay and loamy clay, and impure sand.

In selecting the borrow areas, wash borings were made over an area of 2700 acres and 350 acres were selected, which had an average depth of overburden of 20 ft., and in which test pits were dug at representative locations and samples of the materials subjected to various tests in order to determine their suitability for use in the dam, their slope angles, homogeneity and other characteristics.

The excavating equipment used in the borrow pits consisted chiefly of three 4 cu. yd. bucket and one 2½ cu. yd. bucket steam shovels, supplemented by three smaller steam shovels and a small gas-electric shovel with bucket capacities varying from ¾ cu. yd. to 1¾ cu. yd.; an aggregate bucket capacity of 20 cu. yd. During 1929 these shovels produced a maximum monthly earth output of 701,217 cu. yd. and an average of 513,900 cu. yd., and a maximum daily output of 32,172 cu. yd., working two shifts totaling 21 hrs. a day.

The shovels are served by trains of ten to twelve 12 yd. and 16 yd. side-dump cars, handled over standard gauge track by 40-ton and 60-ton steam locomotives; there being 17 locomotives and 160 dump cars. The average length of haul, measured to the center of gravity of the dam, was one mile.

The above description is abstracted from an article by Arthur R. Wellwood, Major, Corps of Engineers Reserve, who is resident engineer of the work, in the July-August 1930 issue of the "Military Engineer," the Mills Bldg., Washington, D. C., to which we are indebted for the illustrations.

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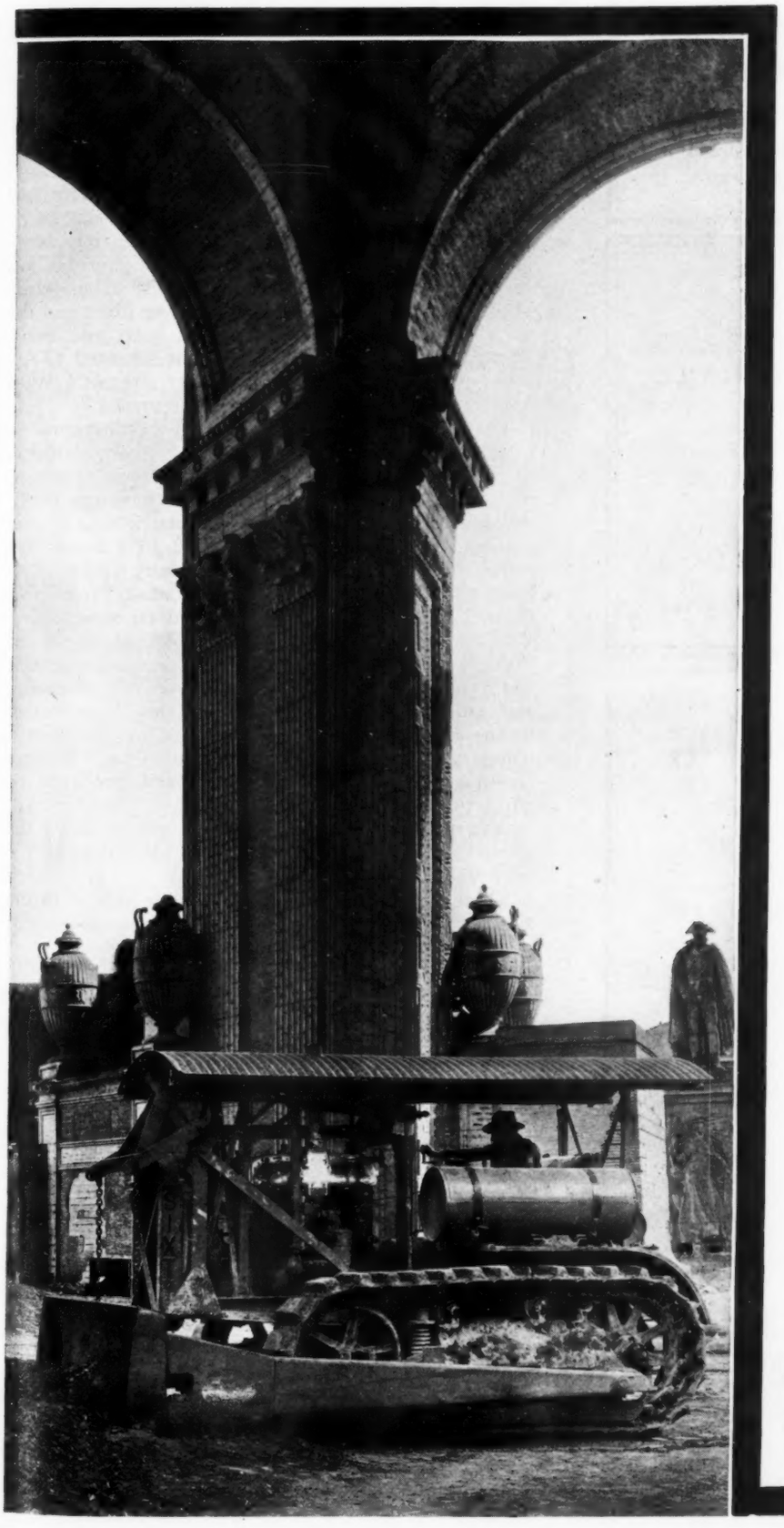

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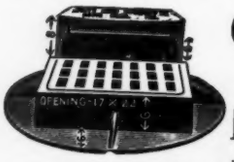

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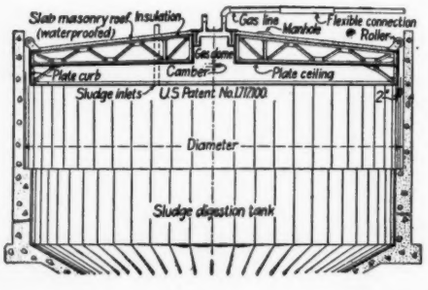

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Present Practice in Industrial Waste Treatment

(Continued from page 22)

wool or cotton fibre, oils and spent dye liquor. Such waste has been successfully treated by coagulation with alum, sedimentation, and intermittent sand filtration at the rate of 100,000 gallons per acre per day. This treatment should produce a clear and stable effluent. At one plant it was found advisable to adjust the pH value to 6.0 before adding the alum. The sludge from the sedimentation process can be dewatered on sand beds.

Decolorization of dye wastes is sometimes difficult. Generally, coagulation followed by filtration brings about considerable color reduction. Trickling filters of coke, slag or crushed stone do well. Activated carbon filters would also decolorize effectively but would probably be expensive to construct and operate.

It appears that no economical and completely satisfactory method of treating wool scouring wastes has yet been devised. These wastes consist of the rinse water, which contain only dirt and some fibre, and the scouring wastes, which carry dirt, soap and much grease. Rinse waters have been fine screened (3/32 inch opening) and allowed to enter streams. Wool fibre retained on the screen can be returned.

For the scouring wastes, the acid-cracking process has been used. It does not, however, give a satisfactory effluent. The method consists of first removing grit from the wastes in detritus tanks having a retention period of about one hour. Sulphuric acid is then applied, to decompose the soap and soda ash of the wastes to alkali sulphates and free fatty acids. This results in sludge and scum which contain the grease. These are drawn off and dewatered on sand filters. The cake so obtained is then hot-pressed to remove the grease, which is salable. The liquid or effluent of the acidifying tank has a very high oxygen demand and requires further treatment. Some improvement in the effluent has been accomplished by coagulation using alum and large quantities of lime. Further treatment on a trickling filter would probably be effective.

According to experiments, after grit removal the waste can be coagulated with alum, without using the acid-cracking process.[3]

The grease, dirt and colloidal matter appear in the sludge. The sludge can be filtered and grease and other by-products removed. The effluent of this process is far better than that of acid-cracking, but can be expected to have an oxygen-consumed value of 250 to 650 parts per million, indicating that further treatment is necessary.

Paper Mill Wastes

These wastes are of several kinds. The liquor from the boilers in which the wood or stock is treated, known as boiler waste, is strongly chemical although rather small in amount. It has been applied to land with success. At some plants it and the water used to wash the boiled stock is evaporated and the residue incinerated to recover the chemicals used. The sulphite process produces acid wash waters for which no adequate treatment method has been devised. Some of it is converted into useful by-products, but the demand for the by-products is not equal to the supply. The transportation water and that from the paper machines contains much wood fibre and is known as white water. Losses of transportation water, which add materially to the white water, can be prevented. Lost stock from the machines is being recovered by

[3] Snell, F. D., "Treatment of Wool Washing Wastes." Industrial & Engineering Chemistry, Vol. 21, No. 3, March, 1929.

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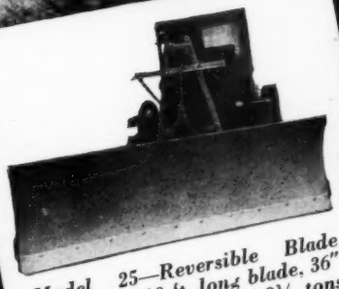

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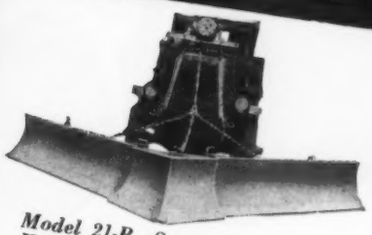

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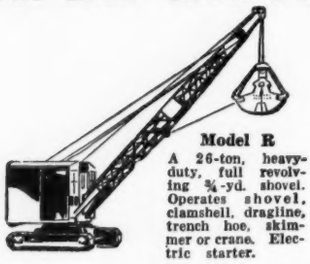

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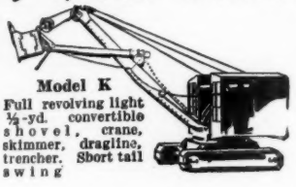

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patented sedimentation processes and returned to the plant. The water after separation is reused. Mixed wastes have been settled in plain sedimentation tanks and finally treated on coke or cinder filters.

Wastes from strawboard factories are very high in suspended solids, which are largely inorganic but contain much organic matter also. Suspended matter will amount to 800 lbs. per ton of board [4] manufactured, and the oxygen-consumed value of the waste is about 1800 parts per million. It is highly alkaline, owing to the lime used in digesting the straw. Actual volume of the waste liquid may be reduced by using the less concentrated machine waste to wash the digested fibre. Plain sedimentation, with a 2-hour period, followed by filtration on screened cinders at a rate of 200,000 to 400,000 gallons per acre per day, is the most suitable treatment method. The large volumes of sludge will be troublesome, but drying on the usual type of bed will remove 80% of the moisture.

Coke By-Product Wastes

The wastes from the ammonia stills contain phenol which, particularly in combination with chlorine, produces disagreeable tastes and odors in public water supplies. Phenol also, when discharged in large amounts into sewers, may interfere seriously with the action of a sewage treatment plant.

The liquid wastes can be used to quench the hot coke. This method, while permissible if the coke is to be used for blast furnace purposes, cannot be employed if the coke is to be sold for domestic purposes because of the odor imparted to it.

Up to 80% or more of the phenol can be removed from the still liquors by washing with such organic solvents as benzol and then recovering the phenol and benzol. For many plants the value of the phenol may not equal the cost of recovery.

The remaining wastes, after being dephenolized, have been treated on trickling filters which have been habituated to phenol. Wastes partially dephenolized by the above method when diluted with 50% or more of domestic sewage could be treated in the usual municipal sewage disposal plant without serious impairment of its efficiency.

Mohlman [5] has found that an intermittent sand filter will handle sewage containing 25 to 35 parts per million of phenol successfully and reduce the phenol by about 95%. There is some evidence that an activated sludge plant will successfully treat sewage containing a like amount of phenol. Since the untreated wastes contain 2000 to 3000 parts per million of phenol, it would appear that sewage should not contain more than 1% of waste. Even then it would probably be safer to provide additional aeration or filter area. A recently designed municipal English sewage treatment plant of the activated sludge type provided 50% additional aeration capacity because of 0.5% of coke wastes. This indicates that pretreatment at the industrial plant would probably be more economical.

Experimentally, the treatment of phenol wastes which have not been partially dephenolized [6] has been found to be possible on coke filters. The wastes were first diluted with liquid which had already passed through the filter, and only very low rates of application could be used—10 to 20 gallons of ammonia still waste per 24 hours to one cubic yard of filter mate-

[4] Hommon, H. B., "Treatment & Disposal of Strawboard Waste," Public Health Bulletin No. 97, U. S. Public Health Service.

[5] Mohlman, F. W., "The Biochemical Oxidation of Phenolic Wastes," American Journal of Public Health, Vol. XIX, No. 2, February, 1929.

[6] Sperr, F. W., "Disposal of Phenol Wastes from Coke By-Product Plants," American Journal of Public Health, Vol. XIX, No. 8, August, 1929.

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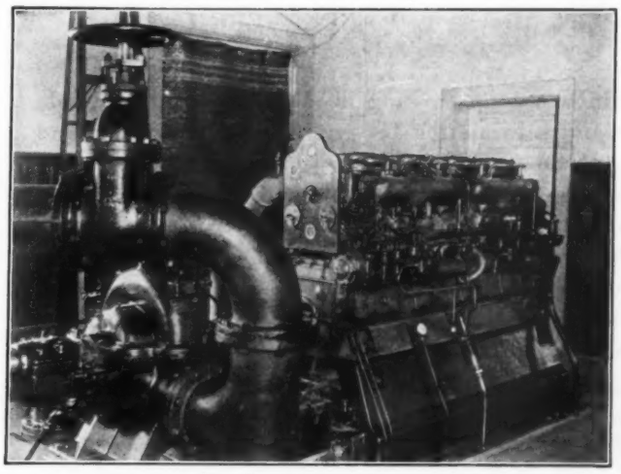

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rial. It was also found desirable to mix humous material, as peat, with the coke and aerate the bed artificially.

Practically speaking, dephenolization followed by dilution with sufficient amounts of domestic sewage appears to be the best method of disposal of this waste. In emergencies, disposal by quenching of the coke is possible. If no domestic sewage is available for dilution, dephenolization with final treatment on coke filters can be used where water supplies are likely to be impaired.

Acid Wastes From Steel Mills

Wastes from metal cleaning are highly acid and should be neutralized before being discharged into streams or sewers. This can be accomplished by 2 to 5 minutes contact with porous calcium carbonate. Travertine, a natural porous limestone, has been recommended for this purpose. Brass-cleaning wastes have been neutralized in tanks, three in series, containing ¾-inch to 1-inch dolomitic limestone, and a fourth, as a final treatment, containing ¼-inch to ½-inch high-grade limestone. At the end of the day, each tank is flushed with clean water and the sludge so removed is settled out.

Mine Wastes

In some states the drainage from coal mines is causing damage to water supplies and to streams. The wastes, although occasionally alkaline, are usually acid with very little or no dissolved oxygen. The mine owners have, until lately, been favored by the courts, to the damage of those cities depending for water upon the polluted streams. A recent decision, however, required mine owners to convey drainage from used workings to a point below a waterworks intake, and to seal abandoned works.

Sealing of abandoned mines is the only remedy which has so far been applied. The Kaplan process, reported from West Virginia, shows promise. It consists of adding to the mine water a complex chemical substance which reacts with the chemicals present to form a blue pigment. The pigment has a value considerably greater than that of the reagent used.

Barrington Sewage Treatment Plant

(Continued from page 34)

sludge and at the same time supplies the mixture with atmospheric oxygen. The sewage leaves the aerating tank over rectangular weirs 8 ft. long into the final settling tanks.

Final Settling Tanks

There are three final settling tanks, each 12 by 36 ft., with the outlet end 6 ft. 9 in. deep and the floor sloping one foot toward the inlet end, where there are two 6 by 6-ft. hopper-shaped sumps in each tank. Each hopper is equipped with a two-inch perforated spray pipe. The sludge which settles in the tank is pushed into the sumps by means of a Link-Belt sludge collector traveling at speed of about 20 feet per hour. The three collectors are connected to a speed reducer, which is driven by a 2 H.P. motor. They are started by means of a push button located on the filter operating floor. By means of three jaw-type clutches, the collector of either tank can be thrown into or out of operation. The effluent pipes from the aeration tanks are cross-connected so that either tank can discharge into any of the final settling tanks. Branches from this pipe, which is of 8-in. cast iron, introduce the sewage into each tank through two inlets, one over the center line of each hopper. At the outlet end of the settling tank the effluent passes over a rectangular

(Continued on page 82)

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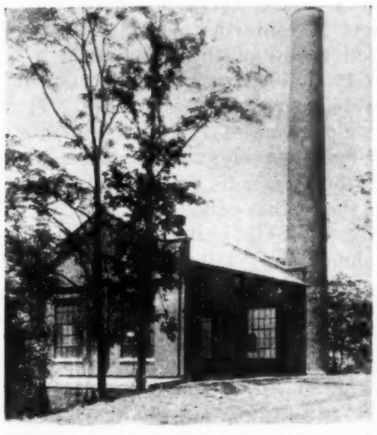
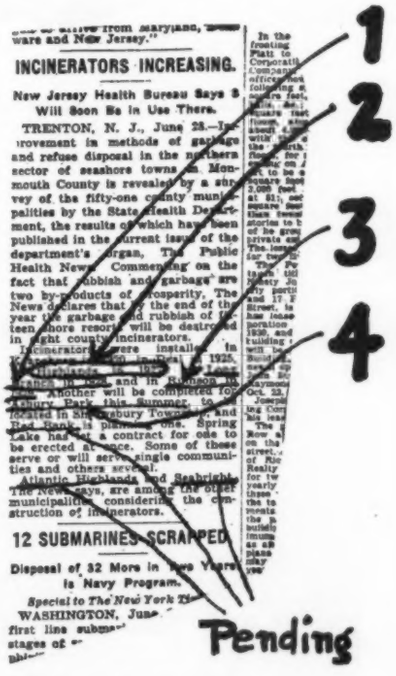


Highlands, N. J. can dispose of 25 tons of refuse per day in this Pittsburgh-Des Moines Plant

THE New York Times of June 29th says that modern incinerators are rapidly increasing—and are also improving municipal disposal methods for garbage and rubbish, those two by-products of prosperity. The Public Health News, official organ of the New Jersey State Health Department, finds that 15 seashore resorts in Monmouth County will be kept clean and healthy by 8 incinerator plants at the end of 1930.

Of the 7 incinerators now in operation, it is significant that 4 were designed and erected by Pittsburgh-Des Moines Steel Company—namely, the Asbury Park, Highlands, Long Branch and Rumson plants.

The Pittsburgh-Des Moines Incinerator is today rendering a reliable economic performance for progressive American Communities in every section of the Country. It operates efficiently at 1500° Fahrenheit, or above, to give complete combustion of all refuse without smoke or odors. The unit system of furnaces permits the addition of more units to keep capacity in line with the growth of population.



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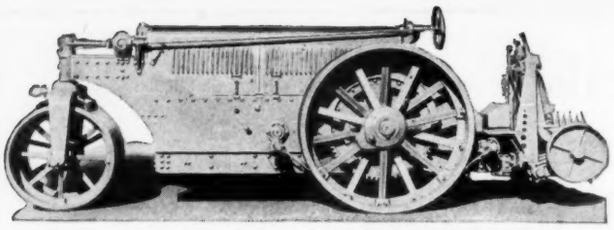

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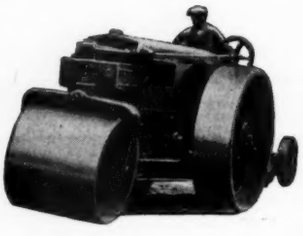

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(Continued from page 80)

weir 11 ft. 6 in. long into a concrete flume, from which an 8-in. pipe carries it to the filter building.

Sludge is removed from the hoppers in these tanks by air-lift through a vertical 6-in. cast-iron pipe placed in each hopper, on top of which is placed a flange through which slides a 5-in. brass pipe which is provided with a 90° V notch weir 3 in. high, through which the sludge flows into a concrete flume.

From the flume the sludge passes through a 6-in. cast-iron pipe to the sludge digestion tank, where it enters one compartment of the rising well just outside the tank which has been referred to.

(To be concluded)

Present-Day Water Treatment Processes

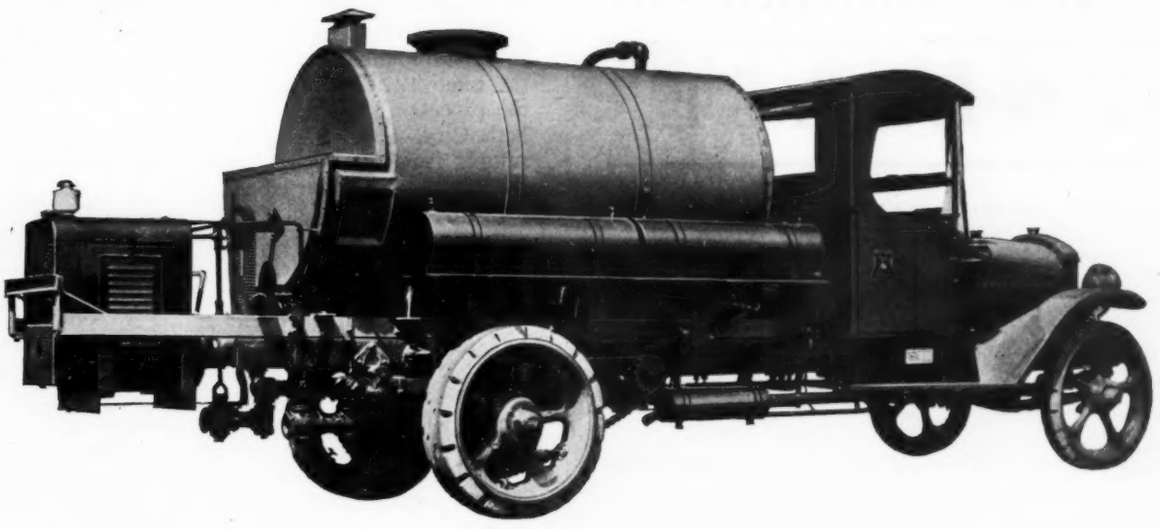
(Continued from page 62)

sands, causing checking. This condition also has been alleviated in some instances by prechlorination.

Water supplies containing phenols have been the cause of very severe criticism. As soon as chlorine is applied the phenol taste is accentuated to such an extent that the consumers clamor for relief. Sir Alexander Houston of the Metropolitan Water Supply of London, England, carried out some very interesting experiments using ammonia followed by chlorine for the eradication of phenol tastes. The first plant to use this method in this country was at Greeneville, Tenn. The method of adding the ammonia is simple and inexpensive. The ammonia cylinder is placed on platform scales and the gas conveyed to a water tank through metal tubing. The valve on the ammonia cylinder is opened until there is a crackling noise. Then the ammonia is allowed to run until the proper quantity has been absorbed by the water in the tank. The ammonia solution is then fed from the tank into the water through an ordinary orifice box. With the orifice box calibrated, any desired quantity may be fed. There also seems to be a possible field for pre-ammoniation in eliminating other odors and tastes, particularly those due to algae. An ammoniator was recently installed in a plant using river water. The river is unusually low and there is some taste and odor, mostly musty. Prechlorination was started and the ammonia added ahead of the chlorine in a ratio of 1:2. On the day following, the water developed a most disagreeable fishy taste and odor. It was thought that it would be necessary to discontinue the treatment, but in about two days this condition cleared up, leaving the water free from any perceptible taste or odor. What probably happened was that the relatively large numbers of algae in the settling basin and filters were immediately killed, thereby releasing the oils responsible for the fishy taste and odor. The small number in the raw water are killed and the odor is not noticeable now. Another point that has been brought out in relation to pre-ammoniation is that the water may be overdosed with chlorine with no danger from taste and odor of chlorine. In this way if a highly contaminated water is being treated the operator can play safe without the danger of subsequent complaints from the consumers.

Permanganate also has been used with success in eliminating phenol tastes. Howard at Toronto has been using superchlorination and dechlorination with sulfur dioxide very successfully.

Another recent development for the elimination of tastes and odors is the use of activated carbon. Baylis at Chicago has carried out some very interesting experiments with the activated carbons. His results seem to show that there is going to be a field for the



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use of this material. There are one or two plants in Germany using activated carbon on a plant scale and it has been found necessary there to reactivate the carbon with steam after about three months use.

Chlorinated copperas has been used successfully at two or three plants in the south where the problem was the removal of high colors. Two of the plants using the process are located at Chicasaw, Ala., and Elizabeth City, N. C. At the Chicasaw plant the color ranges from 40 to 130 p.p.m., and practically complete removal is effected and with economies over the use of other coagulants. The same results were obtained at Elizabeth City. Very complete descriptions and results obtained from the use of this process have been discussed in the technical publications.

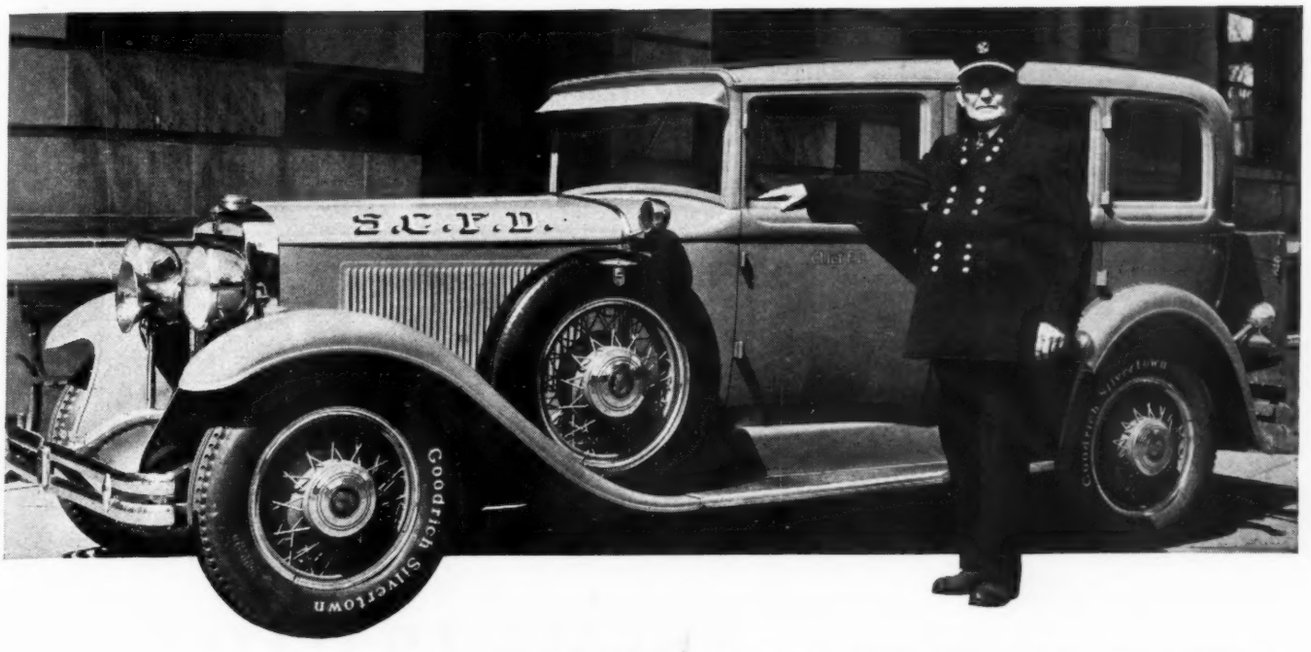
The use of sulfuric acid as an aid to coagulation has found a limited field and is applicable only to certain types of waters, as with others as good results can be obtained without the use of the acid and by using it the cost of treatment is increased.

Iron removal. Waters containing sufficient iron to cause staining are generally treated for iron removal. The removal of iron from the waters in the south is a relatively simple process. Probably the best example is the plant at Memphis, Tenn. Water is obtained from deep wells, pumped by air into a ground level reservoir, then repumped to coke aeration trays and flows by gravity to rapid sand filters. Practically complete iron removal is obtained. Chemical precipitation of the iron with lime followed by filtration is used in a few plants, while one plant is using precipitation with lime followed by sedimentation with good results.

Architecture. The architectural appearance of water purification plants is receiving much more attention than formerly. The psychological effect of attractive surroundings is well known, and surely it will work to the advantage of the community both from the sense of pride which will be instilled in the men responsible for the operation and upkeep of the plant, and by the impression left on visitors to it. Experience has shown that a layman places considerable stress on the appearance of a plant and many times it means the difference between having the confidence of a city in its purification plant or continual discussion and criticism. The purification plant is constructed for the purpose of producing an acceptable water for the consumers and, since considerable expense and technical science are involved, everything should be done to produce the water under the best possible conditions. A dirty plant or slipshod operation is not conducive to best results. Little additional effort or expense is required to keep the plant scrupulously clean. A small expenditure for paint works wonders around the building, while a few flowers add materially to its appearance.

The illustrations of the Lakewood Water Company's plant show how attractive a small plant can be made. This plant has a capacity of seven hundred thousand gallons a day. Originally a circular settling tank constructed of wood was used, but this did not prove entirely satisfactory so a concrete straight flow through settling basin was constructed and the old settling tank torn down. The extension to the building housing an additional filter unit covers the space formerly occupied by the tank. The stone used in the building is native limestone obtained close by. It is privately owned and serves an outlying section of Nashville, Tenn. The cost of construction was $46,000. This does not include a single-cylinder diesel engine used to generate power for the plant and also light a few houses during the period the plant is operated. At other times the local power is switched on.

Fire Chief feels SECURE . . .



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Engineering Societies

September 22-26—NEW ENGLAND WATER WORKS ASSOCIATION. Annual convention at Atlantic City, N. J. F. J. Gifford, Secretary, Dedham, Mass.

September 24-27 — INTERNATIONAL CITY MANAGERS' ASSOCIATION. Annual meeting at San Francisco, Calif. Executive Secretary, Clarence E. Ridley, 923 East 60th Street, Chicago, Ill.

October 6-11—SIXTH INTERNATIONAL ROAD CONGRESS at Washington, D. C. Secretary General, Thomas H. MacDonald, Washington, D. C.

October 7-10—AMERICAN ROAD BUILDERS' ASSOCIATION. International Exposition of Highway Equipment and Material at Washington, D. C. Secretary-Director, Charles M. Upham, National Press Building, Washington, D. C.

October 9-11—INTERNATIONAL ASSOCIATION OF STREET SANITATION OFFICIALS. Annual Conference at Louisville, Ky. A. M. Anderson, 100 No. La Salle Street, Chicago, Secretary.

October 13-17—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual meeting at Richmond, Va. Secretary, C. W. S. Sammelman, 315 Commercial Building, St. Louis, Mo.

October 27-31—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting at Fort Worth, Texas. Executive Secretary, Homer N. Calver, 370 Seventh Avenue, New York.

December 1-5—ASPHALT INSTITUTE. Ninth Annual Conference at Memphis, Tenn. Asphalt Institute, 250 East 43rd Street, New York.

International Association of Street Sanitation Officials

The 11th conference of the International Association of Street Sanitation Officials will be held at the Brown Hotel, Louisville, Ky., October 9 to 11.

The list of subjects to be presented at the conference is as follows:

1—A Woman's Viewpoint of the Importance of Clean Streets to a Community. Mrs. John Pilcher, President, Louisville Women's City Club, Louisville, Kentucky.

2—The Effect of Street Cleanliness upon Real Estate Values. C. Robert Peter, Director of the Louisville Real Estate Board, Louisville, Ky. Discussion by H. J. Neely, Dept. of Highways & Sewers, Pittsburgh, Penna.; I. W. Nelson, Street Dept., Ottawa, Ont., Canada; Lieut. Barnardo Wolf, Supt. Street Sanitation & Cleaning, Havana, Cuba; Dr. M. B. Herlong, City Commissioner, Jacksonville, Fla.

3—(A) Advertising the Service of the Public Works Department—How to Sell the Department to Citizens. Capt. Harrington Place, Engineer, Detroit Bureau of Governmental Research, Detroit, Michigan. Discussion by Elmer C. Goodwin, E. M. Shafter, Adolph J. Post, C. Ricksecker.

4—Reduction of Organic Waste by Bacteriological Inoculation. (Results of experiments conducted by the City of Dearborn, Michigan.) Illustrated by slides. Mark B. Owen, Commissioner of Public Works, Dearborn, Michigan.

5—Salvage of Material in Municipal Refuse. Thomas L. Costigan, Supt. of Street Cleaning, Washington, D. C. Discussion by J. J. Jessup, City Engineer, Los Angeles, Calif.; Philip A. Merian, City Engineer, New Britain, Conn.; H. L. Killam, Supt. of Street Cleaning, Columbus, Ohio; M. J. Nolan, Deputy Commissioner Public Works, Yonkers, N. Y.

6—Report of Committee on Uniform Street Sanitation Records. Joseph J. Petranek, Chairman, Commissioner of Public Works, Cicero, Illinois; L. E. Dempsey, Chief Sanitary Department, Greensboro, N. C.; W. G. Bank, Asst. Eng., Bureau Street Cleaning, Newark, N. J.; Mark B. Owen, Commissioner of Public Works, Dearborn, Mich.; A. S. Tew, Supt, Street & Garbage Dept., Mobile, Ala.

7—Advantages of Bag Containers in Refuse Collection. Arthur P. Heyer, Director of Public Works, Montclair, N. J., Discussion by W. G. Mitchell, Supt. Street Cleaning Dept., Norfolk, Va.; Roy B. Suitor, Supt. of Public Works, Niagara Falls, N. Y.; Claude Vander Molen, Assistant Supt. of Highways, Grand Rapids, Mich.

8—A Sanitary Garbage Collection Ordinance. Carl Schneider, Mechanical Engineer, Division of Public Works, New Orleans, La.; Discussion by William Sydow, Supt. Division Municipal Wastes, Miami, Florida; Frank T. Raught, Supt. Garbage & Ashes, Binghamton, N. Y.; Irving Stone, Supt. of Incinerator, Providence, R. I.; C. G. Choppell, Supt. of Streets, Raleigh, N. C.; Martin H. Zink, Supt. of Public Service, Highland Park, Mich.

9—Snow Removal. (A) Mechanical; (B) Melting. (A) Presented by James Garberg, Supt. of Streets, Minneapolis, Minn.; (B) Prof. Howard T. Barnes, McGill University, Montreal, Quebec, Canada. Discussion by E. A. Wood, Chief Street Cleaning Division, Winnipeg, Man., Canada; James J. Lennon, Commissioner of Public Works, Albany, N. Y.; N. M. Keller, Commr. Sts. & Public Works, Waukegan, Ill.; I. R. Weedon, Supt. of Street Cleaning, Flint, Michigan; M. J. Cronin, Commissioner of Public Works, Utica, N. Y.; C. O. Davis, Supt. Bureau of St. Sanitation, Milwaukee, Wisc.

10—The City Dump—Public and Private—Its Management and Control. Joseph J. Butler, Supt. Bureau of Streets, Chicago, Illinois. Discussion by Archer M. Soby, Chief Bureau of Street Cleaning, Philadelphia, Penna.; Henry Dreyer, Supt. of Street Cleaning, Akron, Ohio; Louis P. Booz, City Engineer, Perth Amboy, N. J.; Edward A. Gerlach, Supervisor Garbage & Ash Collection, Milwaukee, Wisc.

11—Advantages and Disadvantages of Having a Cleanup Week. Covington K. Allen, Engineer of Street Cleaning, Baltimore, Md. Discussion by M. S. Murray, Director of Public Works, Kansas City, Mo.; H. D. Bradley, Deputy Street Commissioner, Toronto, Ont., Canada; Vann E. Ohl, Supt. of Streets & Public Impts., Clairton, Pa.; P. J. Owen, Supt. of Street Cleaning, San Francisco, Calif.; C. F. Twidy, Commissioner of Public Works, Mt. Vernon, N. Y.; J. C. McAllister, Supt. Sanitary & Street Depts., Fayetteville, N. C.

12—What is the Proper Type of Street Crossing Construction within the Railroad Track Zones that will promote Street Cleanliness. P. J. Hurtgen, Director of Public Works, Kenosha, Wis. Discussion by A. J. Paul, Supt. of Public Works, Ann Arbor, Mich.; Edwin A. Miller, Supervisor of Maintenance, Rochester, N. Y.

National Paving Brick Manufacturers Association

The twenty-fifth Annual Meeting of the National Paving Brick Manufacturers Association will be held at the William Penn Hotel, Pittsburgh, Pa., February 4-5-6, 1931. The program for the last two days will include papers and discussions of the latest practices in the design and construction of streets and highways, particularly the vitrified brick type.

The program, now under preparation, will be presented by prominent engineers and paving authorities. It will include descriptions of recently constructed brick super-highways and discussions of such subjects as the resurfacing of old pavements with vitrified brick; the salvaging of old brick in reconstruction projects; fillers for vitri-

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The Bell System is an American institution which consistently builds ahead of the communication needs of the day and year. Its construction program for 1930 requires the expenditure of approximately 700 million dollars.

The scope, speed and accuracy of its service is dependent on the constant research of more than 5000 scientific workers, new methods of operation and construction, and the co-ordinated efforts of more than 450,000 widely scattered employees. All its efforts are centered on giving the public a steadily improving telephone service at the lowest possible cost. This is the accepted responsibility of the Bell System.

fied brick pavements; efficient management of brick paving contracts; and highway research applied to brick pavements.

The Annual banquet will be held Thursday night, February 5th, and business conferences will be held on the first day of the meeting.

George F. Schlesinger, formerly State Highway Director of Ohio, is Chief Engineer and Managing Director of the National Paving Brick Manufacturers Association.

The Missouri Water and Sewerage Conference

The sixth annual meeting of the Missouri Water and Sewerage Conference will be held on October 23, 24, and 25, 1930, at Columbia, Missouri, headquarters, Tiger Hotel.

The aim of the program committee is to cover the more important phases of water production and purification as well as sewage disposal. More time is being allotted to distribution, pumping, and general problems, in conjunction with the important items of water purification and sewage treatment.

It is the desire of this committee to cover the problems most important to the individual members, therefore, each member should help by requesting that their own difficulties be discussed. Send suggestions regarding the program to H. D. Petors, Secretary-Treasurer, State Board of Health, Jefferson City, Missouri.

Southwest Water Works Association

The nineteenth annual convention of the Southwest Water Works Association will be held at Amarillo, Texas, September 15-18. The secretary, Lewis A. Quigley, Superintendent of Water Works of Fort Worth, Texas, has gotten out one of his original notices of this event—the notice alone, in our opinion being worth the price of being a member. The Association covers the states of Missouri, Kansas, Arkansas, Louisiana, Oklahoma and Texas.

New York State Sewage Works Association

The fall meeting of the New York State Sewage Works Association will be held at the Onondaga Hotel, Syracuse, N. Y., Sept. 13. At 10:45 a. m. the technical session will start with papers on "The Use of Chlorine in Connection With Plant Operation" by L. H. Enslow, and "Stream Pollution From the Operator's Standpoint," by Prof. E. B. Phelps. After lunch a trip, starting at 2 p. m., will be made to visit the Syracuse main plant, sludge disposal at lime waste beds, and sludge digestion and control at the small plant at Eastwood. Technical discussions will be continued at 7:45 p. m. with: "Metal Preservation Above and Below Sewage Surface," by R. S. Rankin; "Garage Wastes," by John F. Skinner; "Experience With Small Pumping Stations," by Harry W. Eustance; "Pumping of Sewage Sludge," by Irving Nevitt.

Personals

J. P. Soderstrom, who has been city manager of Rapid City, S. D., has accepted the position of city manager of the city of Grand Junction, Colo.

Allen Hazen, widely known as one of the leading engineers in the field of water supply, sewerage and hydraulics, died July 26 at Miles City, Mont. He was born in 1869, and was graduated from the New Hampshire College of Agriculture and Mechanic Arts in 1886, later doing special work at Massachusetts Institute of Technology. He was in charge of the sewage experiment station at Lawrence, and later of the sewage plant serving the World's Fair grounds at Chicago. Since 1904 he has been engaged in consulting work. One of his most interesting recent projects was that of the Cobble Mountain Dam at Springfield, Mass., the highest earth dam in the world.

Engineering and Construction Equipment

New Machinery, Apparatus, Materials and Methods and Recent Installations.

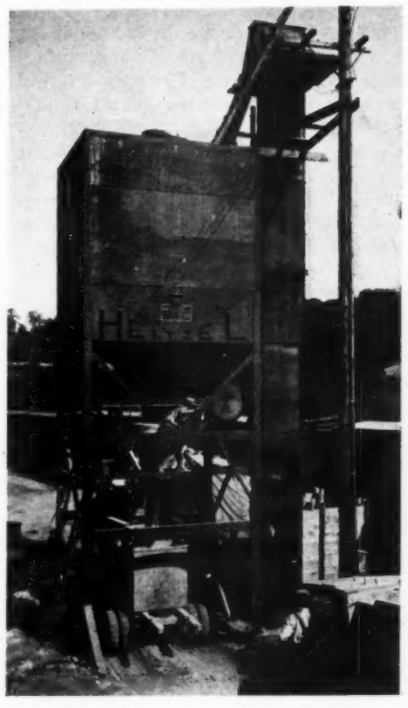
Equipment for Bulk Cement Storage and Handling

Complete equipment for the storing and batching of bulk cement is now furnished by The Heltzel Steel Form and Iron Company, Warren, Ohio.

The basic bin of the Heltzel plant is a portable all-riveted bin having a capacity of 125 bbls. of cement. By adding an inexpensive extension, capacity can be increased to 320 bbls.

The bin is loaded by a vertical elevator and when desired, a power shovel for unloading the bulk cement from box cars can also be furnished. The flow of cement from the bin to the batcher is controlled by an extremely accurate rotary valve arrangement.

The batcher is entirely dustproof, making the use of a dust jacket unnecessary, and eliminating all cement waste through dusting. Weighing is done with an automatic springless dial type of scale, which allows the operator to back check every batch without moving any counterpoises, and which has been chosen because of its extreme accuracy and rapidity of action.



Heltzel Equipment for Handling Bulk Cement

Chausse Portable Sand Drier or Reheater

A new type portable sand drier or reheater for paving mixes, has been announced by the Chausse Oil Burner Company of Elkhart, Indiana. This machine has been developed to meet the necessity for rapidly heating and drying sand or stone for railway and contractor's uses, or for reheating premixed and natural asphaltic paving repair materials.

It consists of a rotating drum with internal cascading blades, mounted on SKF self-aligning ball bearings and enclosed in steel housing. The drum is turned by a LeRoi single cylinder, 4-horsepower, radiator cooled engine, with Twin Disc clutch and Cotta reducing gear, through hardened roller chain.

An important feature of this machine is the indirect application of heat. It is equipped with two Chausse self generating kerosene burners, located within the steel housing underneath the rotating drum. These apply the heat effectively on the outside of the drum and no high temperature flame comes into contact with the drying or heating materials. This is especially valuable in handling bituminous mixes which can be very easily damaged in open flame type heating. It is also important in drying certain mineral sands and aggregates which explode and turn to fine dust if too severely or highly heated.

The machine is mounted on rubber tired steel wheels, with roller bearings, and has a steel towing tongue. Kerosene is stored in a 30-gallon welded steel tank and pressure is supplied by a 3-inch hand operated air pump. Several sizes and capacities can be furnished.

Euclid Hydraulic Operated Bulldozer

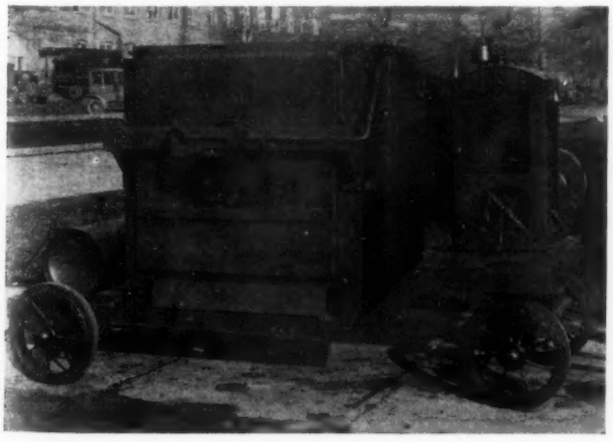
A recent addition to the line of Euclid earth moving equipment is the Euclid hydraulic operated bulldozer.

It is proving exceptionally valuable to earth moving contractors on all bulldozing work. Light in weight, it is unusually strong, embodying many exclusive Euclid features including the specially designed hydraulic pump and lifting jack, leaving the drawbar absolutely free for all uses.

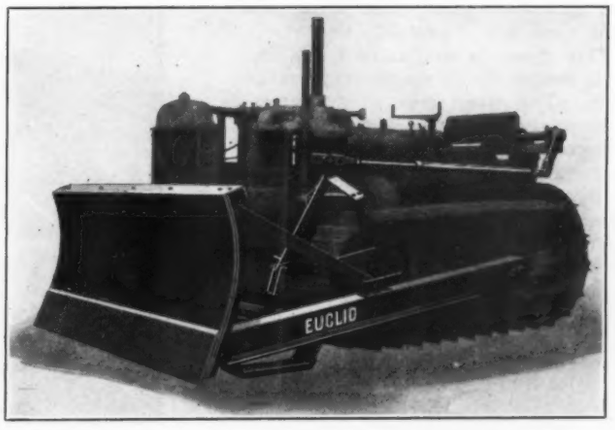
Hydraulic in operation, with complete control within easy reach of the tractor driver, it is easily attached to or detached from the tractor. It is evenly balanced and so constructed that it eliminates the necessity of a two-way jack, while permitting leveling operations so essential on many types of construction.

Cletrac 80-60 Logging Special

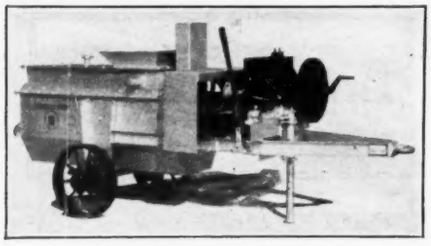
All accessories for the convenience of the logger, clearer and grubber, are found in The Cleveland Tractor Company's latest model, the Cletrac "80-60" Logging Special which is equipped with radiator guard, crank case guard, front bumper and pull hook, spark arrester, together with a lower track wheel guard and instrument panel protection. The tractor is also equipped with an electric starter, which eliminates the necessity of cranking.



Chausse Portable Sand Drier



Euclid Hydraulic Operated Bulldozer



Littleford Grout Mixer

Littleford Grout and Mastic Mixer

The new Littleford mechanical grout and mastic mixer has many advantages. Over the mixing compartment is a screened loading hopper through which sand and gravel is shoveled. Just below the hopper, on both sides of the mixer, is a hose connection that makes it possible to connect the outfit to the draw-off of an asphalt kettle and allow the material to flow directly into the mixer as needed.

There are no vent holes on the sides of the outfit; men can work close to it and not be bothered by fumes or intense heat. All fumes pass out through the vent stack.

The mixer can be used with or without the oil burner, depending on the material to be mixed.

Byers' Model 40 3/4 Swing Utility Shovel

A convertible ⅜ Yard, ¾ swing, clean-up shovel weighing less than 10 tons is announced by The Byers Machine Company, Ravenna, Ohio.

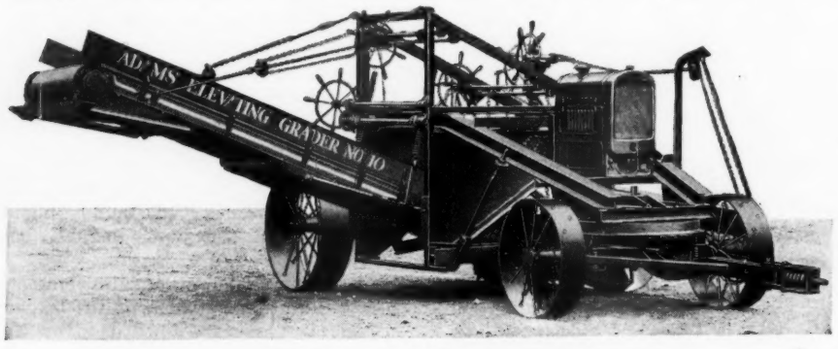
This shovel is similar to Byers' full circle models in its machinery arrangement. The direct type of drive from motor to jackshaft by silent chain and then to each working operation is exactly the same in principle as is found on Byers' ½, ¾, 1 and 1¼-yard machinery decks. All deck machinery is mounted in a one unit steel casting, Timken roller bearings, worm boom hoist and power clutches also are similar.

This machine has a 36 h.p. motor which develops a powerful single line pull at 140 ft. per min. A two-speed crawler successfully climbed up a 40 per cent grade on a recent demonstration. The Model 40 is expected to operate within weight requirements on highways, do miscellaneous and clean-up work around supply yards and on big jobs.

A New Elevating Grader By Adams

A new elevating grader with a number of features has been announced by J. D. Adams Company, manufacturers of Adams Leaning Wheel Graders and other road building and maintenance equipment.

The new features include the use of anti-friction bearings throughout—Timken roller bearings in wheels and Timken and ball bearings throughout carrier and carrier drive—a new shaft and gear driven carrier, a new carrier construction which provides unusual rigidity with light weight, a new automatic pan cleaner, belt tightener, etc.



Adams Elevating Grader with Important New Features

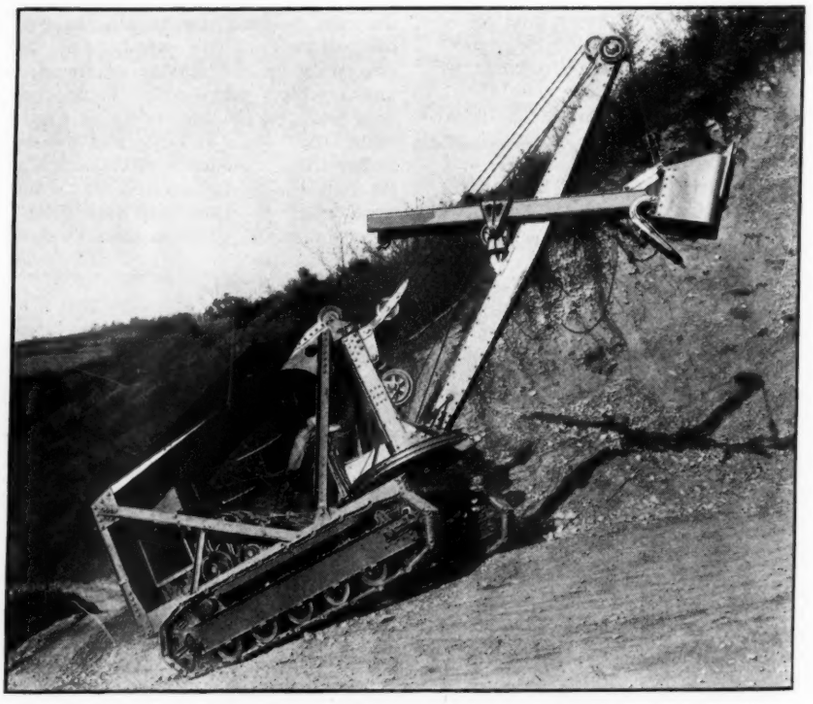
Probably the most outstanding feature of the new Adams Elevating Grader is the new type carrier which is driven by shaft and enclosed gears instead of by the usual chain. The rear axle drive has been entirely eliminated.

The upper drum and lower roller of the carrier are mounted on ball bearings and all carrier rollers are mounted on Timken bearings. The carrier rollers are tubular steel and the Timken bearings are carefully encased inside the rollers fully protected from dirt.

The machine is furnished with power take-off or auxiliary motor, either of which drives the carrier with much less power than required by the old rear axle drive, and makes the carrier operation independent of tractive conditions. The machine uses a 42 in. belt and is regularly equipped with 28 in. disc plow.

A New Type Portable Ammoniator

The Paradon Mfg. Co., of Arlington, N. J., have recently developed a portable ammoniator. The apparatus consists of a standard Paradon Type ADB Ammoniator, housed in a fibre carrying case, resembling a piece of hand luggage. In design, it is essentially like the familiar type of Paradon chlorinator excepting that the parts are made of material that will withstand the corrosive effects of ammonia. A shut-off valve is provided to keep moisture and foreign material out of the apparatus during periods of non-use. No water supply is necessary for its operation, the ammonia gas being applied directly. The apparatus can be supplied for any range of capacity from one pound of ammonia per 24 hours to 300 pounds of ammonia per 24 hours. Equipment can also be supplied that would decrease the minmum capacity to .05 pounds of ammonia per 24 hours.



The Byers Model 40 Utility Shovel Going Up a Steep Grade

WILLIAMSPORT WIRE ROPE

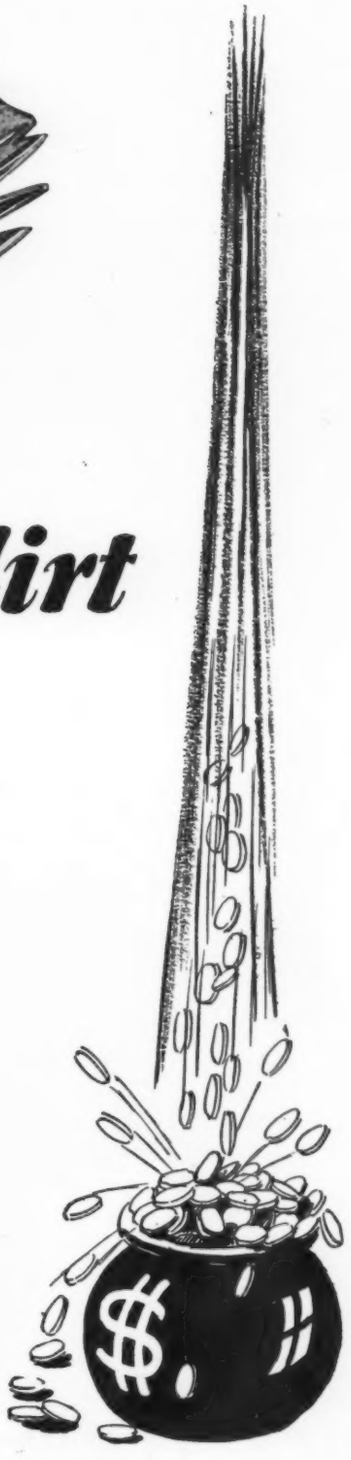
gets the pay dirt

Williamsport Wire Rope almost invariably lasts beyond the average life of a rope. This extra service is "pay dirt" for the user. The reason for this extra life is due to uniformity of Tensile Strength and physical characteristic of each wire.

There's no need to have one good wire in Wire Rope unless they are *all* good.

You'll find, through the Williamsport process of manufacture, all wires in a rope are very uniform in strength, and because of this, longer life is generally obtained from its use.

Most engineers know this. You too can benefit from this added service by using "Williamsport."



WILLIAMSPORT WIRE ROPE CO.

Main Office and Works:
Williamsport, Pa.

General Sales Offices:
122 So. Michigan Ave., Chicago

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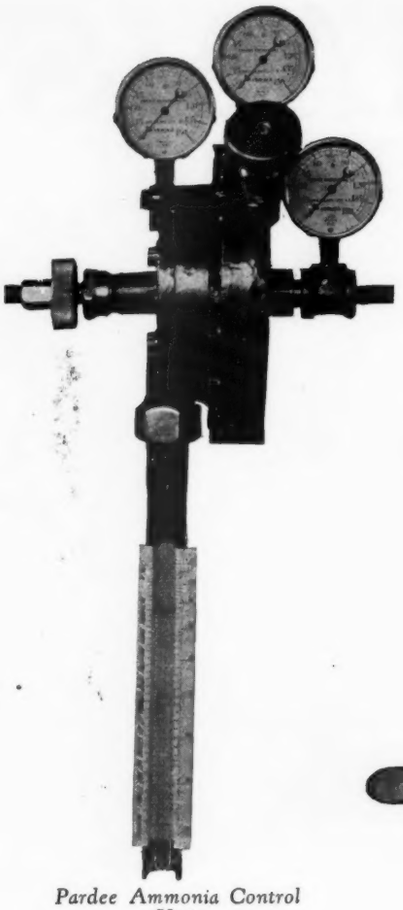
Pardee Ammonia Control Unit

The Pardee Engineering Co., Long Island City, N. Y., has developed this unit for the application of ammonia to water supplies or for any other place where accurate control is needed. It consists essentially of a control valve, a meter which shows how much gas is flowing, two diaphragm valves which automatically maintain the flow, and auxiliary gauges to aid in operation. It will apply from 0.02 to 200 pounds of ammonia per day, it is claimed, depending upon the type of meter used. The smallest type will handle from 0.02 to 1 pound per day, and the largest from 40 to 200 pounds; intermediate sizes operate under a wide variety of capacities.

The Pardee Manufacturing Co. also manufacture chlorine control apparatus which is generally similar in construction and operation.



Pardee Ammonia Control Unit

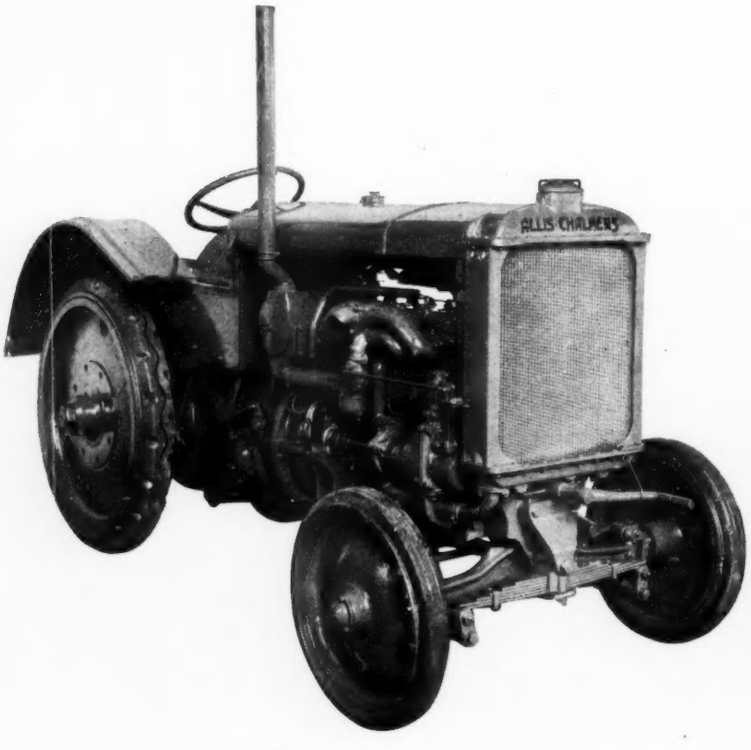
Narrow Tread Tractor by Allis-Chalmers

A new narrow tread tractor has been announced by the Allis-Chalmers Mfg. Co. for use around warehouses, docks, freight yards, and on construction where a tractor must work in close quarters. It has an outside width of only 47 inches.

The narrow tread tractor is an adaptation of the Allis-Chalmers Model U (United) industrial tractor. Front and rear wheels were brought in closer to the tractor by shortening the axles. Certain other changes in design were also made to keep the job narrow throughout. Spring mounted front axles are furnished when desired.

Rear wheels are of standard diameter but those in front have been made smaller. Small front wheels permit short, quick turning, which is an advantage for close-range work. Front tires are 24 x 3½ and rear tires 40 x 5.

A four-speed transmission is standard equipment, providing four speeds forward and one reverse. In fourth gear the tractor travels up to 20 miles an hour.



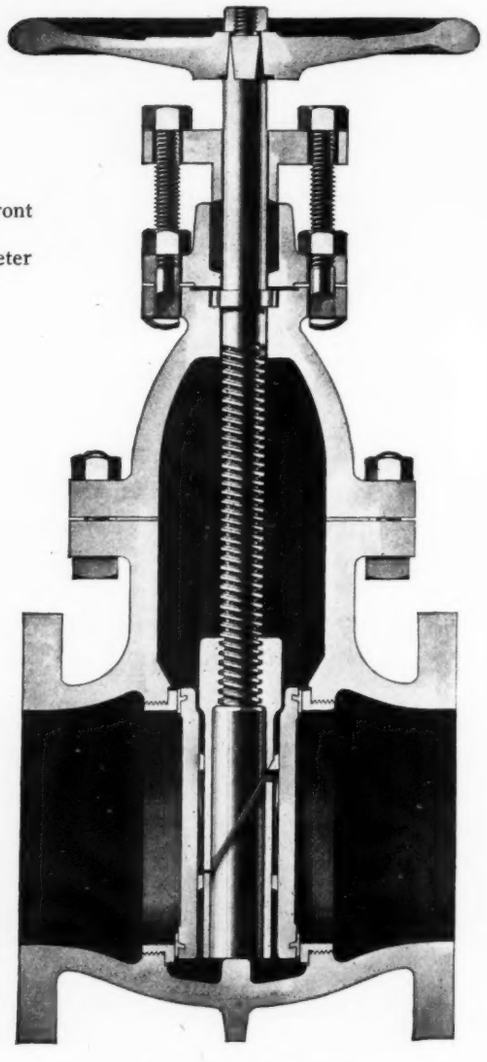
Allis-Chalmers Narrow Tread Tractor

New Jenkins Bronze Valve

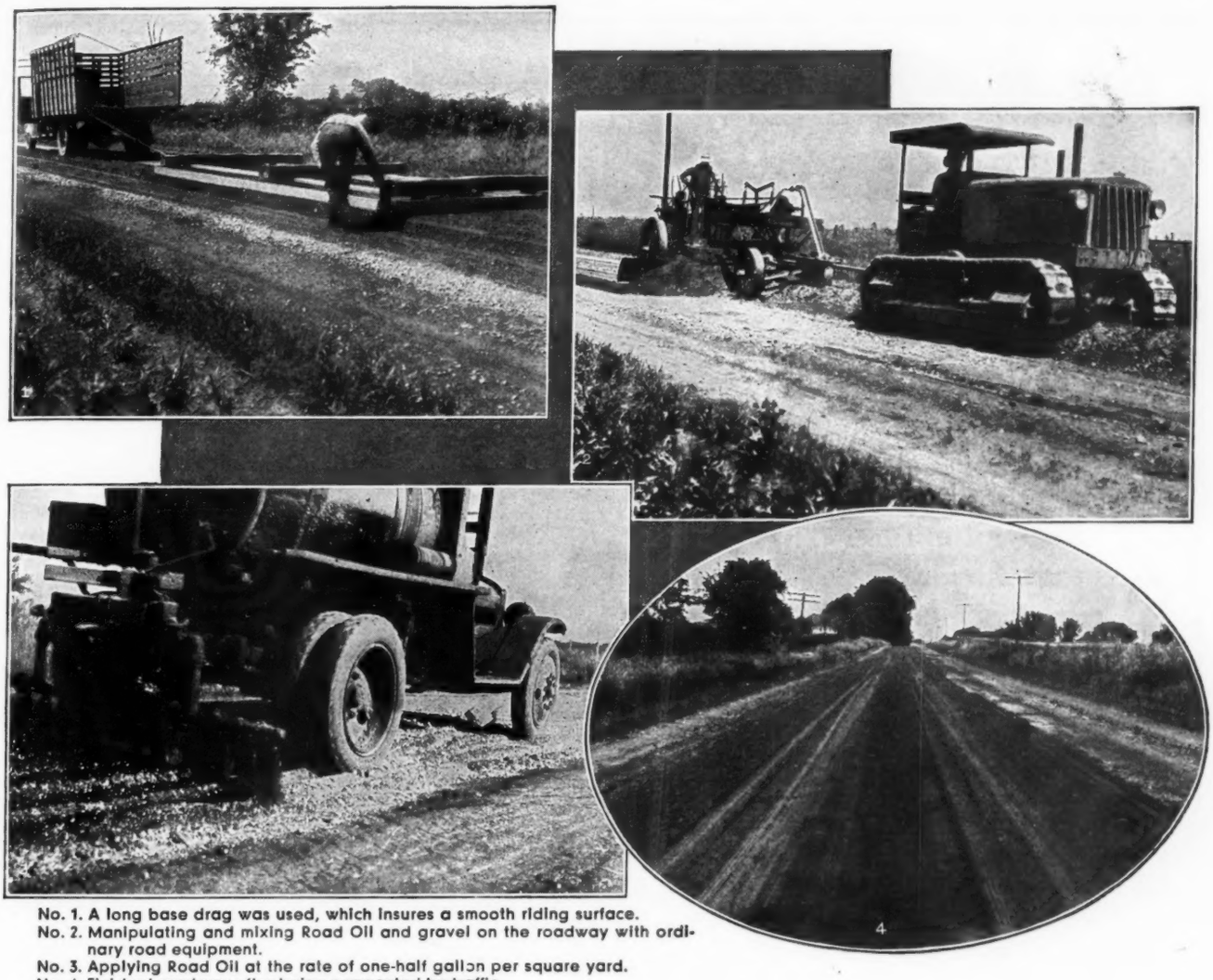
The new Bulletin No. 141 which fully describes and illustrates Jenkins Standard Bronze Valves with the one-piece screw-over bonnet and slip-on stay-on disc holder has just been announced by Jenkins Bros., 80 White St., New York.

The valves described are made in globe, angle, cross and check types for all standard services. The globe valve is designated as Jenkins Fig. 106-A.

The one-piece screw-over bonnet in combination with the slip-on stay-on disc holder is an entirely new departure in bronze valve design. The one-piece bonnet construction provides ease in



Jenkins Standard Valve



No. 1. A long base drag was used, which insures a smooth riding surface.
No. 2. Manipulating and mixing Road Oil and gravel on the roadway with ordinary road equipment.
No. 3. Applying Road Oil at the rate of one-half gallon per square yard.
No. 4. Finished roadway after being compacted by traffic.

A 3" ROAD OIL WEARING SURFACE BY MIXED-IN-PLACE METHOD

Of all low cost types of roads now being constructed throughout the United States, the mixed-in-place method develops the most miles of good all-year roads at the lowest first cost and lowest maintenance cost.

Thousands of miles of roads throughout the country testify to its success.

It is rapidly becoming the almost universal method of producing low cost roads, and we recommend it where conditions are suitable.

We will gladly inspect any particular road to be improved and advise as to the suitability of the mixed-in-place method.

STANDARD OIL CO. (Indiana)

137 West 11th Street Indianapolis, Indiana

Billings	Denver	Fargo	Joliet	Mason City	Saginaw	South Bend
Cheyenne	Des Moines	Grand Rapids	Kansas City	Minneapolis	Sioux City	St. Louis
Chicago	Detroit	Green Bay	La Crosse	Milwaukee	Peoria	St. Joseph
Davenport	Duluth	Huron	Mankato	Minot	Quincy	Wichita
Decatur	Evansville	Indianapolis				

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STANDARD ASPHALT ROAD OIL

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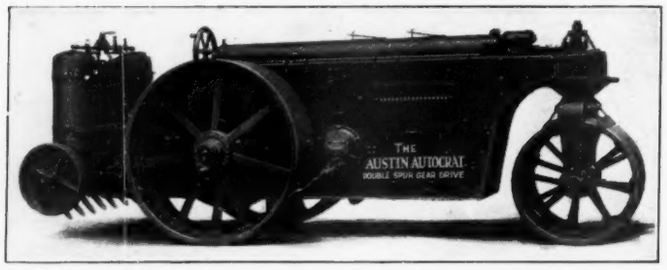
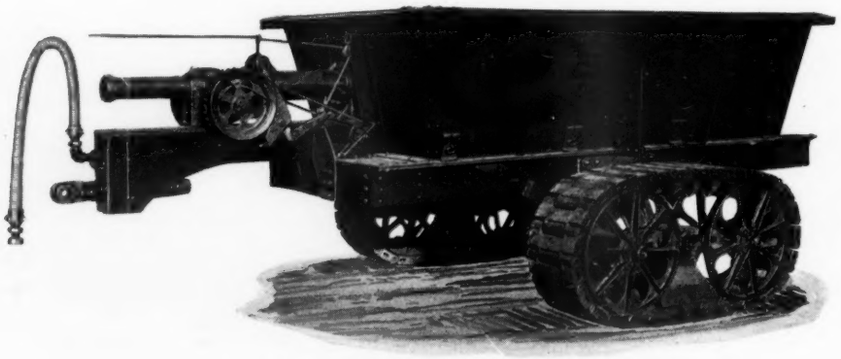


The Austin Autocrat Road Roller

removal, and contributes unusual strength, which, it is claimed by the manufacturer, prevents springing or distortion, even though the bonnet is removed and replaced repeatedly. The valve throughout is heavily proportioned.

The slip-on disc holder facilitates changing the disc. If the spindle is raised just a turn or so, the bonnet can be removed from the valve body without danger of the disc holder slipping off the spindle. Then a turn or so in the opposite direction and the disc holder slips off the spindle.



La Plant-Choate Six-Yard Crawler Wagon

Humphryes Self-Priming Centrifugal Pump

The Humphryes Mfg. Co., Mansfield, Ohio, states that with their new self-priming centrifugal pump the contractor can, with a totally dry pump, start the engine, and in half a minute have a discharge of 600 gallons per minute. The pump primes itself not only under unusual conditions, but over and over again throughout the day as needed, without attention, and no matter how scant the flow of water.

This pump also can be used as a force pump, and has a total head and lift up to 50 feet.

New Ford Powered Brookville Locomotives

The new Ford "AA" truck power plant is utilized for light locomotive haulage by two new series of Brookville locomotives in 2, 2½, 3, 3½ and 4-ton sizes.

Maximum mobility and power is attained with a minimum of motor wear and effort by the use of a four speed heavy duty Ford transmission, in conjunction with a Brookville reverse drive, which makes all four speeds available in either direction. In low gear the Ford "AA" motor is sufficiently powerful to slip all four drive wheels of a 4-ton Brookville locomotive, equipped with steel tires, operating on a dry sanded rail—and the steel tires (supplied as standard equipment with these Brookville locomotives) provide 25 per cent more traction than do ordinary chilled face drivers. Yet, in high gear, this same locomotive will attain a speed of 15 miles per hour. And at this speed the locomotive will negotiate light trackage without derailment, due to the use of Brookville spring journals and wide wheels with deep flanges.

As the entire power plant, including Ford clutch and transmission, are used without alteration, inexpensive and expert service is always available from Ford dealers.

Austin Autocrat Road Roller

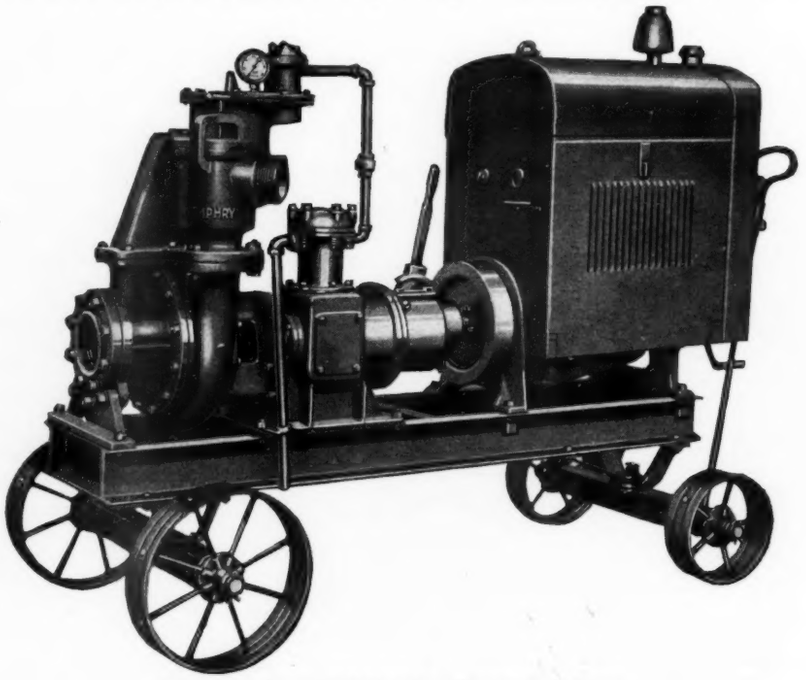
The Austin-Western Road Machinery Co., Chicago, Ill., has just placed on the market a new and better roller, with double spur gear drive. In addition, it has the advantages of a superabundance of power for scarifying and other hard work; an unusually short wheel-base, which adds to its handling qualities; ease of steering and handling; and an exceptionally low center of gravity, which eliminates side sway.

La Plant-Choate Six-Yard Crawler Wagon

La Plant-Choate Mfg. Co., Inc., Cedar Rapids, Ia., has brought out a 6-yard crawler wagon which is equipped with 10-ton track, and has full bottom escapement. This wagon may be used singly, or in trains of two or more. It can be turned in its own length. It can be equipped with either hand-winding or hydraulic door-lifting mechanism.

The body is built entirely of steel, hot riveting and electric welding being used throughout its construction. The ¼ inch side body plates are bent at the bottom to form the angle which is fastened directly to the frame, giving one-piece construction. The doors are ⅜ inch steel and are equipped with heavy angles riveted on for reinforcement. The upper edge of the body has a molding which prevents the body from spreading.

The wagon is equipped with tracks built under license of patents belonging to the Caterpillar Tractor Co.



The Humphryes Self-Priming Centrifugal Pump

BAKER SNOW PLOWS

For Motor Trucks and Tractors

They Have Served the Nation for Over Twenty Years

Baker Snow Plows have been at it for over twenty years. It pays to select from the forty odd models of "V" and blade plows for standard trucks and industrial tractors. Before you make your decision, be sure to get Baker's 56 page Snow Plow Catalog No. 290 full of the latest information on modern snow movers. If you need other tractor equipment ask for our General Catalog No. 280.

BAKER TRACTOR EQUIPMENT
EARTH MOVING-ROAD MAINTENANCE-SNOW REMOVAL

Snow Plows ☐ Bulldozers ☐ Baker Maney Scrapers ☐

THE BAKER MFG. CO., 525 Stanford Ave., Springfield, Ill.

A Real "He-Man" Pump for Contractors

—A Quality and Low Price Combination

Absolute Self-Priming from a dry start — no need to carry water to help prime

High Suction Lift 27 ft. Maximum

Automatic or Manual Control Priming

Popular Size— 4″ or 3″ Suction— 3″ Discharge

Fig. 857—VC-3T Unit

Ball Bearing Shaft —Extra Heavy

Open-passage, Wide, Trash Handling Impeller —special design

Ample Power—10 hp. 4 cyl. Radiator-cooled Engine

Extra Large Capacity —425 g.p.m. on 15 ft. total head

The only Contractors' Pump having all these high-grade features ever offered at such a low price—

$600.00 plus freight from Shippensburg, Pa.

Carried in stock by Distributors in principal cities throughout the U. S. A.
Write today for descriptive bulletin and name of nearest dealer.

DOMESTIC ENGINE & PUMP CO., *Manufacturers* **Shippensburg, Pa.**

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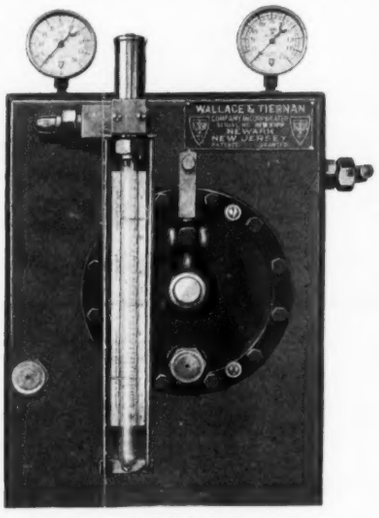
The Highway Trailer Scraper for Moving Dirt

Highway Trailer Co., Edgerton, Wisc., manufacture a power-driven, self-loading, one-man operated scraper that is claimed to pick up a load of dirt in 50 seconds. It is said to do, with one man and a 30 hp. tractor, as much as 5 teams and 8 to 9 men. This machine digs, scrapes, loads, elevates, hauls, dumps and distributes the dirt where wanted. It is made in 2, 3½ and 5½-yard sizes, for 20, 30, and 60 or larger tractors.

This machine has been used successfully by both contractors and county highway forces. Recently some machines were sold for construction work in Mexico.

Wallace & Tiernan Ammoniator

Wallace & Tiernan, Newark, N. J., have brought out an ammoniator, which is stated to have several advantages. It

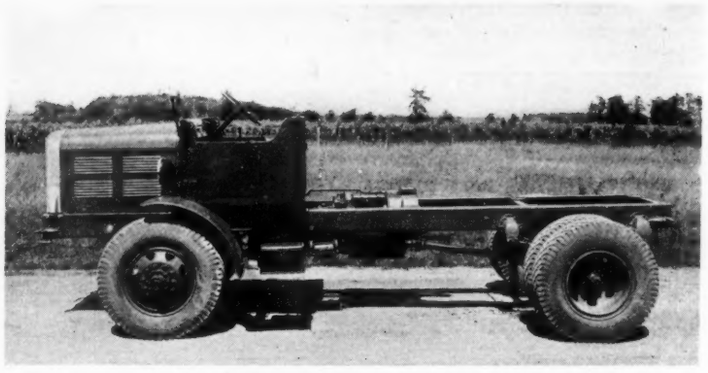


W. & T. Type MDWA Ammoniator

has a guaranteed accuracy of four per cent. All parts in contact with ammonia are of non-corrosive material. It has double protection against back flooding of the apparatus by water; first the water-gas check valve located at the point of application, secondly the long sight glass provided for detection of water leakage past the check valve.

The Type MDPA ammoniator (application in open well) or the Type MDPAM ammoniator (application to a main) can be furnished with pedestal mounting (standard) or with brackets for wall mounting. It has an accurate range of flow for rates of ammonia as low as 0.5 pounds per twenty-four hours to as high as two hundred pounds per twenty-four hours. A pressure reducing valve and compensator maintain uniform feed of ammonia regardless of pressure changes in the ammonia cylinder.

For those who already have standard MSP or MDP chlorinators, they have developed an ammoniator which may readily be attached to the chlorinator, thus giving a combination equipment with all control apparatus at one point.



New Model FWD Super Truck

FWD Super-Five and Super-Seven Motor Trucks

Four Wheel Drive Auto Company, Clintonville, Wisconsin, announces the incorporation of two new model FWDs in its line of four-wheel-driven trucks. These two moguls, known as the "Super-Five" and the "Super-Seven," are respectively of five, and seven-and-one-half tons capacity.

Both have wheel bases of 165 inches, loading space behind cab of 156 inches, and 72 inches tread. Each has a six-cylinder motor, developing for the five ton, 102 b.hp. at 2,000 r.p.m., and for the 7½ ton truck, 127 b.hp. at 2,000 r.p.m.

The selective sliding gear, four speed, main transmission in each, is supplemented by a planetary, two speed, auxiliary transmission; these give in combination, a range of eight forward, two reverse speeds, with direct drive in the eighth. The outstanding feature of the new, patented, FWD planetary step down gear is that it permits the use of a 12 inch silent chain instead of a series of gears.

Both trucks ride on semi-elliptic alloy-steel springs, 48" x 3½" forward and 52" x 4" rear; the "Super-Five" is mounted with heavy-duty balloons, 12.75" x 20", singles front and rear; the "Super-Seven" with pneumatics, 44" x 10", singles front, duals rear.

Highway Trailer Scraper Moving Dirt

Civil Service

Civil and Mechanical Engineers.—Applications for principal civil engineer, $5,600 to $6,400 a year; senior civil engineer, $4,600 to $5,200 a year; senior electrical engineer, $4,600 to $5,200 a year; senior mechanical engineer, $4,600 to $5,200 a year; civil engineer, $3,800 to $4,400 a year; mechanical engineer, $3,800 to $4,400 a year must be on file with the Civil Service Commission at Washington, D. C., not later than September 10, 1930.

The examinations are to fill vacancies in the Bureau of Reclamation, Department of the Interior, and vacancies occurring in positions requiring similar qualifications, for duty in Washington, D. C., or in the field. Positions in connection with the Boulder Dam project will be filled from these examinations; also in connection with designs and specifications for the proposed All-American Canal of the Reclamation Service.

Information.—Full information may be obtained from the United States Civil Service Commission, Washington, D. C., or from the Secretary of the United States Civil Service Board of Examiners at the post office or customhouse in any city.

Publications of Interest to the Engineer

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Monarch "35".—A 30-page illustrated booklet on the new Allis-Chalmers Monarch "35" tractor is being distributed. It contains a brief but complete description of the "35," including mechanical features and performance. Approximately 50 photographs add interest to the booklet and help make it easy reading. The Monarch "35" develops 41 horsepower at the drawbar. Construction features include removable cylinder sleeves, a crank stabilizer which insures positive track alignment, five truck wheels in each truck frame, wheel-type steering, and others.

Disinfection.—"The Paradon Mfg. Co., Arlington, N. J., have recently issued a bulletin known as No. 20-A describing their Paradon Chlorinizer for the application of chlorine solution for the disinfection of small water supplies, sewage plants and swimming pools."

Welding Wire Research.—Facts concerning welding wire research that every welder should know, are included. Tells why ordinary wire will not do for welding, and the effects of impurities on the finished weld. A complete discussion on testing welded plate specimens, shows why the testing procedure should be considered before judging the results from tests on such specimens. Facts concerning the use of a proper flame and a proper welding current are given in detail. The book also shows how to test welding wire by the flame test. Copies of Welding Wire Research may be obtained by addressing the Page Steel & Wire Company, 230 Park Ave., New York, N. Y.

Electric Flow Meters.—The Brown Instrument Company has just issued a revised edition of their Electric Flow Meter Instruction Book. This 40-page book explains the mechanism of the various types of Brown instruments, and gives instructions for installing the equipment, adjusting the instruments for zero readings, and changing range tubes. Of interest is the new low range manometer, which is furnished for measuring the flow of gas or air where the pressure does not exceed 50 pounds per square inch. Practical suggestions for avoiding difficulties are given, and tables of correction factors for pressure, quality, and superheat of steam are presented. Copies will be mailed upon request to the Brown Instrument Company, Philadelphia, Pa.

Diamond Core Drill Fittings.—The Bureau of Standards has published an illustrated pamphlet describing the new commercial standards for diamond core drill fittings that have been adopted as the result of the Bureau's efforts in securing cooperation between manufacturers, drilling contractors and others interested in the subject.

The aim of the new standards is to make diamond core drill fittings, such as bits, casing and rods, as produced by the various manufacturers, interchangeable in the field, in so far as controlling diameters, threads, and dimensions of joints are concerned, and furthermore to provide a convenient series of nesting casings, permitting three reductions in diameter below a three inch hole. The benefit to contractors and other users of the equipment is obvious.

The pamphlet may be procured upon application to the Bureau of Standards at Washington; to C. H. Rohrbach, Secretary of the Diamond Core Drill Manufacturers Association, 90 West Street, New York; or to the manufacturers of the fittings.

Concrete Shore Protection.—To compensate for a lack of general information on the subject, a 32-page booklet on shore protection has just been issued by the Portland Cement Association. This publication deals with waterfront structures generally and shows, by means of much illustrative material, how the protection problem has been successfully handled in various communities. The introduction states that "of all materials available, concrete is the most resistant to the action of the elements, salt water, marine borers, and other destructive agents. Like any other material, it must be used intelligently, with full advantage taken of present-day knowledge, and with due regard to past experience." The booklet is well illustrated, provides much statistical data, and concludes with a table of typical specifications for concrete shore protection structures and a bibliography of reference material intended to simplify the task of making individual research into shore protection problems. The volume is available for free distribution.

Water.—William H. Cater, Chicago, Ill., has published an elaborate catalog on financing, constructing, and maintaining water works for municipalities. This 105-page book gives data and illustrations on a number of installations made in recent years.

The Centrifugal Pump.—Covering every phase of the centrifugal pump from theory to installation and operation, this new bulletin offers the most comprehensive and complete data on its subject that has yet come off the press. It was compiled for Goulds by F. G. Switzer, Professor of Hydraulic Engineering, Cornell University, and is a practical handbook of data. One of the most interesting chapters in the book is that on testing. The user of pumps will also find much of interest in the many valuable curve charts the book contains.

Copies may be obtained from Goulds Pumps, Inc., Seneca Falls, N. Y.

Centrifugal Pumps.—Goulds Pumps, Inc., Seneca Falls, New York, are also distributing the second of their series of Centrifugal Pump Selection Chart Bulletins. This second book covers multi-stage pumps for capacities up to 2000 G.P.M. and heads up to 2400 feet. As with the first book, a comprehensive group of charts enables the prospective pump user quickly and easily to determine just what pump is best suited to his individual requirements. Complete description, including cross sections, bearing details and dimensions for each pump are given.

An increasing number of city and county commissioners are finding the dump-truck-snow-plow combination economical and highly practical equipment. Above is one of the double duty units operating at Port Huron, Michigan. It is a Freeman D-W chassis equipped with a Wood type F-4C Hoist and W-12 body.

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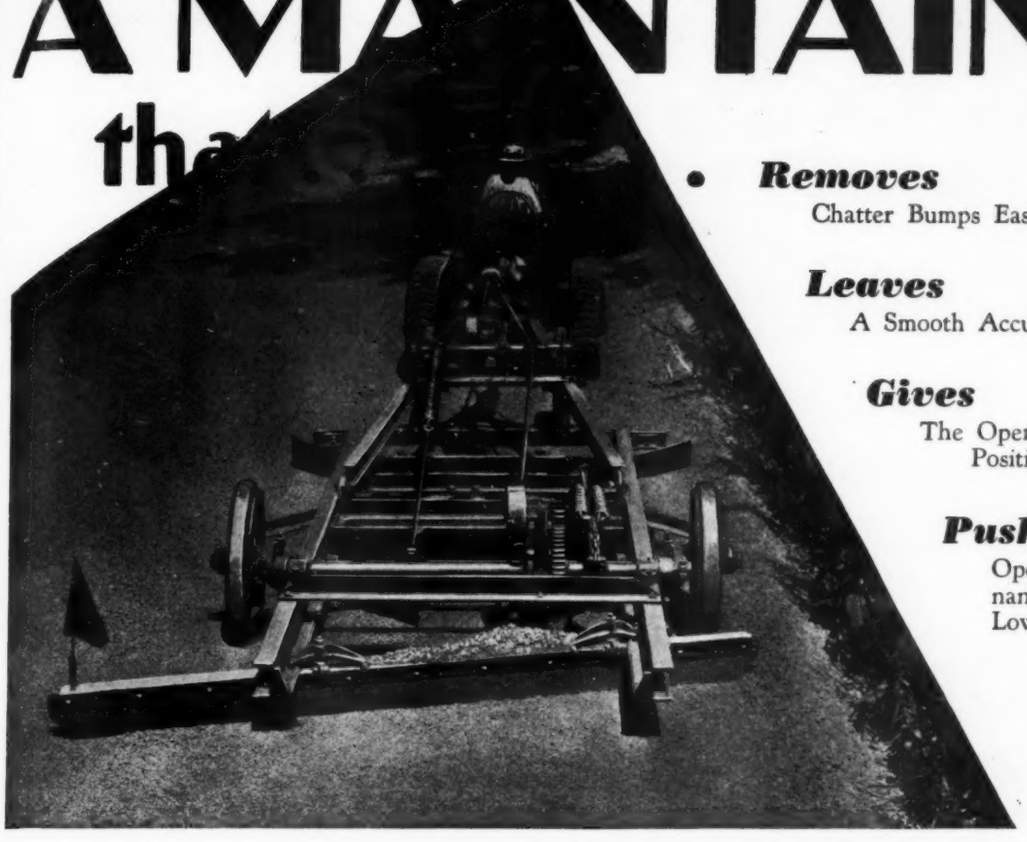

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Seven blades, total length forty feet, work surface four times in one trip. Standard cut is 9 ft. wide; with blade extensions 10½ or 12 ft. Blades rigidly bolted to main frame which is made of 6" heavy ship channel steel securely bolted and welded to cross members.

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Both front and rear axles are one piece cold drawn steel. Rear axle has simple, easily adjusted road crowning device on each side.

Front and rear wheels are identical in design and size — interchangeable to compensate for wear. Equipped with roller bearings and 4 inch rubber tires. Write now for complete data.

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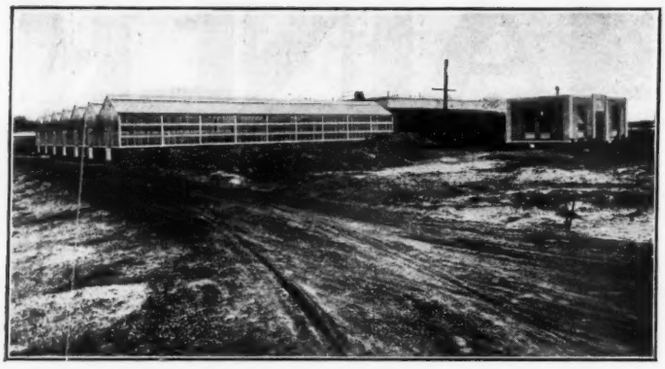

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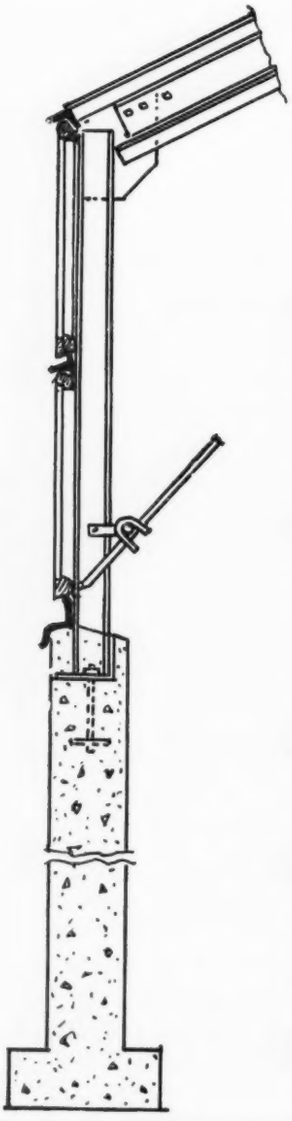

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With Our Authors

Herbert W. Lincoln, who is sales engineer of the Morse Boulger Destructor Co., New York, is a graduate electrical engineer, University of Michigan, 1918. He has had a long experience in electrical heating work, involving such factors as heat transfer, insulation and combustion, which has been of great value in connection with the design of incinerators. Mr. Lincoln saw war service with the signal corps, receiving a commission as lieutenant. He has been with the Westinghouse Company, with other electrical equipment firms, and with the Morse Boulger Co. since 1927. His article describes the design and installation of the Charlotte, N. C., incinerator plant.

N. C. Nickerson, after graduating from the College of Engineering of the University of Minnesota, entered the service of Uncle Sam, serving as private, corporal, sergeant and lieutenant in the Thirty-third Regiment of Engineers. Here he helped erect cantonments motor repair depots and warehouses. After discharge from the army he was chief of party of a topographical survey crew making a survey of the Sheyenne River in North Dakota locating reservoir sites for flood control. When this work was completed he became a designing engineer for the North Dakota Highway Commission and was engaged in the design of the highways of that State.

In 1922 Mr. Nickerson was appointed Highway Engineer for the County of Carlton, Minnesota, which position he now holds. Here he has had a varied experience, as he has had charge of the design, construction and maintenance of Carlton County's roads and bridges and they range from the simplest to the most difficult. The soil of the county varies from sand to clay and from muskeg swamps to solid rock. Nevertheless, the roads of the county will compare favorably with those in any other part of the State.

One of the most difficult pieces of construction was the building of a road through Jay Cooke Park, a tract of land, the topography of which cannot be equalled for scenic beauty anywhere else between the Appalachian and the Rocky mountains. Every tourist traveling in this part of the country will be well repaid for his efforts when he views the beauty of this park and travels over the roads of this county.

James H. Griffin, author of the article on "Engineering Contracts," says: "Having been employed by the Board of Transportation of the City of New York and its predecessors in various capacities since 1913, I find myself in the rather unique position of having been connected with but one project in all that time. That one, however, from an engineering viewpoint, transcends all other single projects in this country or elsewhere. This project is the construction of the Dual System of Rapid Transit Railroads, and more recently the construction and equipment of the Independent System of City-Owned Rapid Transit Railroads. For the first 8 years I was on field work. Since 1921

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VISITORS are quick to approve smooth roads and streets —keenly appreciative of well-kept parks. San Francisco operates "Caterpillar" equipment in Golden Gate Park— on its streets—at its airport. Here's Golden Gate in the background—a Sixty and "Caterpillar" Grader smooth a macadam road. *For all-'round use the year 'round "Caterpillars" serve a city!*

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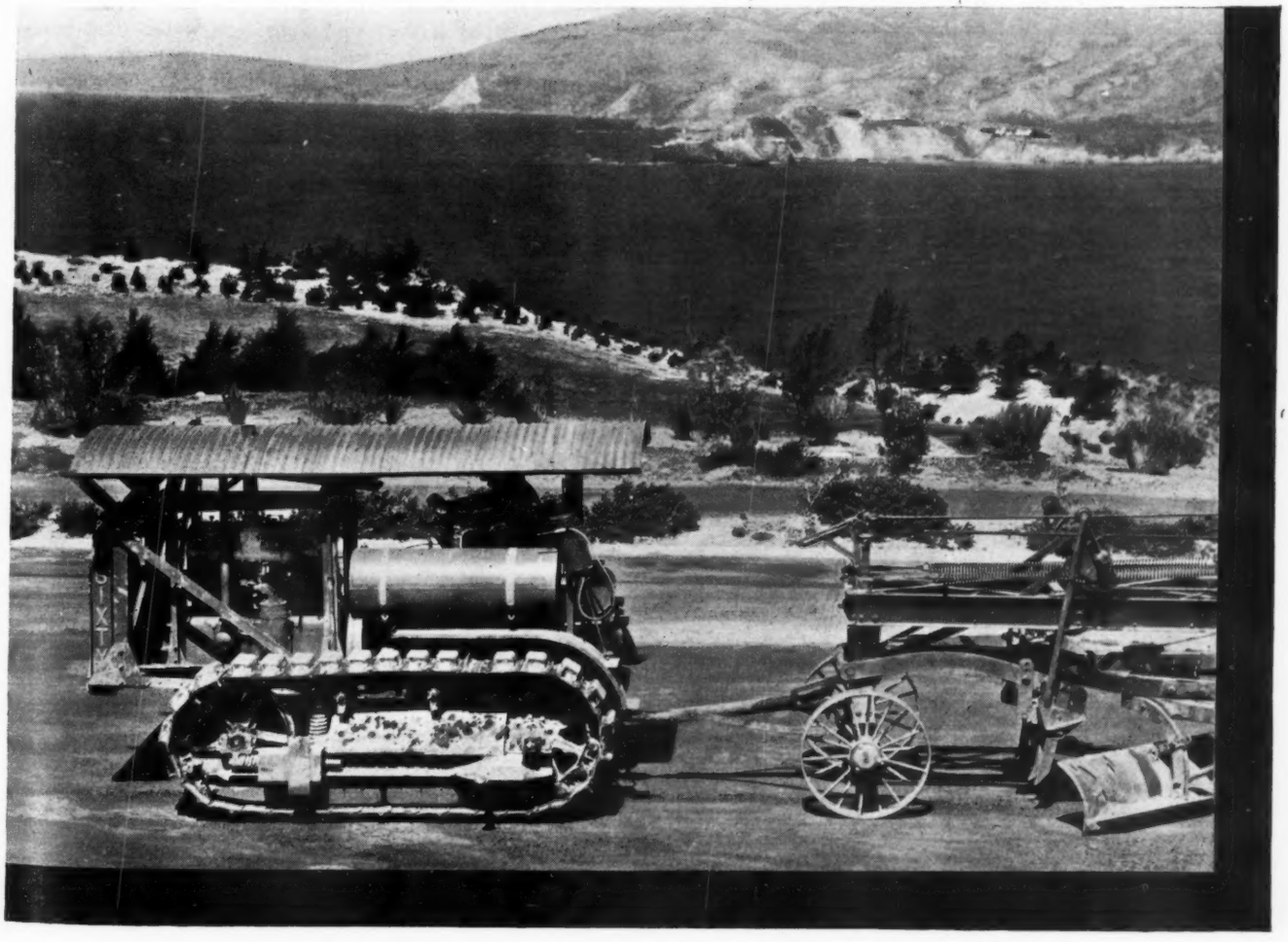

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I have been handling contracts, and since then the contracts and specifications for more than $500,000,000 of construction work have been written by me or under my direction."

Mr. Griffin, who graduated from Union College in 1912, was one of the best football line men that Union ever had. As we recall, he played during his entire course without time out for any injury. During his junior year he set a new record as strong man of the college, and we believe that record still stands. He now holds a commission as captain in the Reserve of the U. S. Army, which he won during the World War. The writer of these notes was a classmate of "Griff", who is so modest that most of this information could never otherwise have been extracted from him.

A. E. Clark, associate sanitary engineer of the Tennessee State Board of Health, is more than widely known in the South. In charge of water supplies in Tennessee for the past five years, he has had a good deal of the experience that falls to all sanitarians in the South—that of accomplishing much with little. To one who has known "Ed" for as long as this writer has, it is not surprising that he has gotten along so well under these conditions, and now has the situation well in in hand. Mr. Clark studied at Rensselaer Polytechnic Institute, Troy, N. Y., and then spent five years in charge of water laboratories in Wilmington, Del., and Portland, Me.; six years in charge of filter plants in Pennsylvania, Ohio, Michigan, and New York, followed by a year and a half in water shed investigation and experimental filter plant work. He has been in charge of the supplies in Tennessee since 1925. He was recently a welcome visitor in the New York offices of PUBLIC WORKS, talking over old times.

In addition to the article published last month on "Present Day Water Treatment Processes," Mr. Clark is author of an article in this issue.

Book Reviews

Best Practice in Highway Engineering

Instructions to Inspectors in the Field. Bulletin No. 17. 258 pages; 87 illustrations. Pennsylvania Department of Highways, Harrisburg, Pa., June, 1930.

Bulletin No. 17 describes the general construction practice of the Pennsylvania Department of Highways. Giving, as it does, these practices of one of the most highly developed highway departments in the country, it is worthy of study.

One paragraph of the introduction is worth repeating here. It should be memorized and put into practice by every public works engineer: "The roads are being built for their owners—the public, and it is your job to see that the work is well done and completed as speedily as possible so that the public will not be unnecessarily inconvenienced by being compelled to use detours any longer than is absolutely necessary."

The Road Contractor demands it

THE ROAD CONTRACTOR demands service from the tires he uses in the daily hard job of highway building. With that he must have another kind of service—immediate delivery service covering the products used on his equipment, however that may be scattered over one or many states.

The large contractor pictured here uses Goodrich Heavy Duty Silvertown and Cavalier Truck Tires, not only because he is getting lower operating costs, but because any one of his 75 trucks in construction work in parts of Illinois and Iowa will be supplied with Goodrich Tires an hour or two after the order is placed.

Goodrich branches and warehouses, strategically located in all parts of the U. S., offer road builders and contractors instant tire service covering all requirements.

ROAD BUILDING requires tires that serve and also tire service. That's why the above large contractor uses Goodrich

The B. F. Goodrich Rubber Company, Established 1870, Akron, Ohio. Pacific Goodrich Rubber Company, Los Angeles, California . . . In Canada: Canadian Goodrich Company, Kitchener, Ont.

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Speed King, one bag trailer outsells every other 7S mixer. Speed does it.

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The contents of this bulletin include: 1—General instructions and duties of engineers and inspectors; 2—Materials: Field sampling and inspection of materials; 3—Earthwork, subgrade, underdrains, subbase and shoulders; 4—Cement concrete pavements and bases; 5—Bituminous wearing surface construction; 6—Bituminous surface-treated macadam surface course and vitrified brick; 7—Relaid block pavement and miscellaneous structures; 8—Concrete bridges and culverts, pipe culverts, endwalls and inlets.

Under each of these heads are given in detail the inspector's duties and good practice in regard to construction. For instance, under "Concrete Bridges" are covered: Foundations, lines, materials, placing, forms and their construction, reinforcement, joints, protection of concrete, concreting in freezing weather, backfilling and keystones. The section on "Cement Concrete Pavements and Sub-Bases," which covers 83 pages and is illustrated with a large number of drawings and illustrations, is a good course on how to build concrete pavements. Fundamental requirements in construction are covered clearly and definitely.

Bulletin 17 is an excellent and thorough text, of value to anyone in the highway field. The man who wrote it deserves a large amount of credit for the clear and succinct manner in which he has covered the ground. The printing is fair, but the half-tones are uniformly poor. A slightly greater expenditure for a better grade of paper would have been justified many times over.

Covering the Field of Sanitation

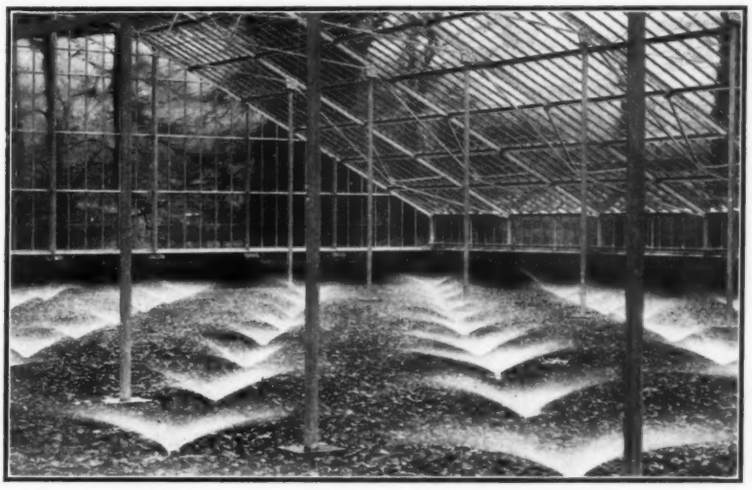
Military Preventive Medicine by George C. Dunham, Major, Medical Corps, U. S. Army; Director, Department of Sanitation, Medical Field Service School. 1051 pages, 197 illustrations. Published as Army Medical Bulletin No. 23.

Reviewed by M. J. Blew

Though the title may not indicate it fully, this book is probably the most complete text-book on public health engineering that is in print. It is written primarily to make available to army officers the basic information regarding military sanitation and to provide approved and accepted bases for their use. However, public health engineers realize that the gap between military and civil sanitation is not a wide one; and they will find in this most complete and carefully written volume an excellent blending of sound training, wide experience, study and observation, and good sense. Major Dunham, though a medical officer, is an excellent engineer, and also has a long list of other degrees. He is a charter member of The Order of the Boar.

It is hard to tell in a brief review what will be found in the thousand pages of this book. Those who have attended the courses in Military Sanitation at the Army Field Medical School at Carlisle, will have a general idea of what is covered, because a good deal of the material has been presented to students at those courses. Of the strictly medical or the strictly military, there is comparatively little, and this is concentrated mainly in the first three and the 8th, 24th and 25th chapters. Chapter IV covers housing and ventilation; the 60 pages of Chapter V is given over to the control of intestinal diseases; there follow 121 pages devoted to water supply and purification; 33 pages on the sanitation of swimming pools; 128 pages on meat and food inspection and dairy and milk sani-

Master Construction Glass-Overs for Sludge Beds



This Sprinkling Filter Glass-Over at Totowa, N. J., is 80′ wide by 126′ long.

Sprinkling Filter Glass-Overs For Controlling of Odors and Nuisance From Flies

THE plant at Totowa, N. J., was among the first to glass over a sprinkling filter. This was done with the idea of controlling the odors from this filter, and all vents were screened to control the nuisance resulting from flies. With the Sludge Bed Glass-Over beside it, and in combination with a settling tank, a flow of 4000 gallons a day can be taken care of.

Both Glass-Overs are made of our Standard Steel Frame Master Construction. All wood used is tank grade cypress. Having been building glass structures for going on eighty years, we know how they should be built. We have a Department of experts specializing in Glass-Overs for sewage work, to whose services you are welcome.

Lord & Burnham Co.

Sludge Bed Glass-Overs

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TRADE MARK

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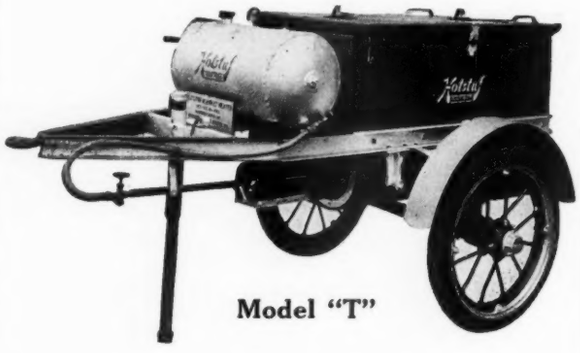

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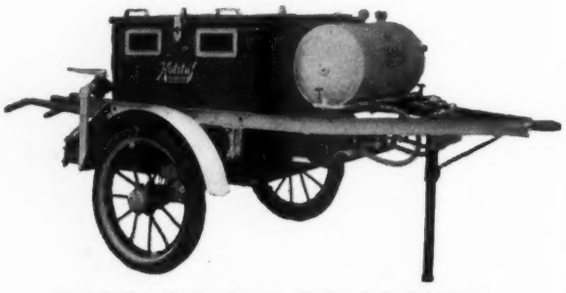

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tation; 28 pages on mess sanitation; 19 pages on the general subject of waste disposal; 102 pages on sewage treatment; 15 pages on excreta disposal for temporary camps; and 50 pages on the disposal of garbage, kitchen wastes and manure.

Fly control is covered in 26 pages; rat control in 25 pages; 47 pages are devoted to the control of insect borne diseases; the control of insects is then taken up, beginning with mosquitoes, with 68 pages, and continuing with lice, 27 pages, and other insects, such as ticks, fleas, bedbugs, roaches and ants, 18 pages.

The control of venereal and miscellaneous diseases is covered in 50 pages of Chapters XVI and XXV. Chapter XVI, of 18 pages, covers sanitary surveys and sanitary orders.

The foregoing material has been listed so as to give the reader an idea of what is covered. It will be seen that nearly 750 pages, or three-fourths of the entire text, are devoted to subjects that ordinarily can be expected to fall, sooner or later, into the desk of the engineer engaged in public health work; and a good deal of it can be expected to present itself to any engineer in municipal engineering.. With this amount of material available, the question of the authority and the manner of its presentation is important.

For the past three years, an average of 40 engineers annually have taken the course in military sanitation at Carlisle. This group has included a number of the leading engineers in the public health field. The impression left on these men by Major Dunham is a complete answer to the question of his ability to write authoritatively on the subject of military sanitation, or any of its divisions. The matter presented here contains no extracts from Army Regulations; no long quotations; no dry presentation of material better available elsewhere. The author has not employed the "modern" method of writing, which means a secretary to clip and file technical magazine articles, and take dictation intended to string together this clipped materal. This book is the product of four years of work, much of it at night.

All the material has been written by hand, most of it rewritten several times. The result is a well-balanced text, presenting a lot of information on what to do and how to do it—in detail and with precision. There is very little space given to anything by pretty well standardized practices, but latest developments are well covered. This reviewer has had the privilege of reading many of the chapters in the original.

It is understood that, as Bulletin No. 23 of the Medical Department, the distributon will be limited to officers of the regular army and to reserve officers who have attended the course in Military Sanitation at Carlisle. We are happy to know that it is the purpose of the author to revise the text for commercial publication, so that this material will be available later for wider distribution.

Bulletin No. 23 is printed on a fair grade of paper, which does not do the half-tone illustrations full justice. The binding is blue cloth. The type selection is good, and the printing and make-up generally are unusually good. The drawings were made by enlisted men, and the printing done by the shop at the Medical Service School. The results are surprisingly good.

Any one engaged in health work who can get a copy of "Military Preventive Medicine" may consider himself especially fortunate.